Nutrition during pregnancy:
How maternal life style factors affect the risk of macrosomia

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Master thesis in clinical nutrition

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Summary

Background: A too low or a too high birth weight has been linked to adverse health risks in both a short and long term perspective. In Norway the prevalence of macrosomic infants (>4000g and 4500g) has increased in the last years. Identifying factors that affect birth weight: are of crucial interest in order to prevent problems pertaining to infants that are born too large. In this study maternal energy intake, energy-adjusted intake of macronutrients and intake of fiber, were examined to identify possible associations with birth weight. Maternal diet was also described.

Design: Cohort study

Setting: Dept. of Obstetrics and Gynecology**,** Rikshospitalet-Radiumhospitalet Medical Centre, Oslo, Norway.

Subjects: A total of 553 pregnant women and their infants. The subjects were followed through pregnancy and delivery during the period of 2002-2005.

Methods: The pregnant women's dietary intake during both the second and third trimester of pregnancy was ascertained in gestational week 14-16 and 30-32 by using a food frequency questionnaire.

Results: A large proportion of the pregnant women had intakes of macronutrients and fiber that were not within the recommended ranges: 66% had too low intake of fiber, 30% too much added sugar, 85% too much saturated fat and 42% too little intake of omega-3 fatty acids in week 14-16. This trend shows a significant deterioration as the pregnant women proceed from the second to week 30-32: they eat more saturated fat, more added sugar and less fiber. High intake of protein in week 14-16 is associated with reduced risk of giving birth to a macrosomic infant (OR=0,5). In univariate analyses, intake of added sugar and omega-3 fatty acids was associated with birth weight.

Conclusion: High intakes of protein have a significant preventive effect on the risk of delivering a macrosomic infant. However, the effects of high protein diets during pregnancy have shown adverse health effects, and should not be promoted. Many pregnant women eat an unbalanced diet, not within the recommended guidelines. Much can possibly be achieved by promoting the already existing recommendations. Especially inactive and overweight pregnant women should be paid special attention.

Sammendrag

Bakgrunn: En for lav eller for høy fødselsvekt har blitt knyttet opp mot økt risiko for ugunstig helse, både på lang og kort sikt i forhold til barn som er normalvektige ved fødsel. I Norge har prevalensen av makrosomiske barn (>4000g and 4500g) økt over de siste årene. På grunn av denne uheldige utviklingen med for mange store barn, er det av stor interesse å avdekke hvilke faktorer som påvirker fødselsvekten. I denne studien ble mors energiinntak, energijustert inntak av makronæringsstoffer samt inntak av fiber undersøkt for å finne mulige sammenhenger med fødselsvekt. Mødrenes kosthold ble også beskrevet.

Design: Kohort

Sted: Avdeling for Obstetrikk og Gynekologi, Rikshospitalet-Radiumhospitalet Medisinsk senter, Oslo, Norge i tidsperioden 2002-2005.

Studieobjekter: Totalt 553 gravide kvinner og deres barn. Mødrene ble fulgt gjennom svangerskapet og fødsel.

Metode: De gravide kvinnenes matinntak ble registrert både i tidlig andre trimester (uke 14-16) og sent i tredje trimester (uke 30-32) ved bruk av FFQ (matfrekvensspørreskjema).

Resultater: En stor andel av kvinnene i "Store barn og komplikasjoner" (STORK) hadde et inntak av makronæringsstoffer og fiber som ikke lå innenfor de anbefalte grenser: følgende hadde 66% for lavt fiberinntak, 30% for høyt sukkerinntak, 85% for høyt mettet fettinntak og 42% for lavt inntak av omega-3 fettsyrer i andre trimester. Denne negative trend ble ytterligere forverret når kvinnene går fra uke 14-16 til uke 30-32 i svangerskapet: de spiser mer mettet fett, mer tilsatt sukker og mindre fiber. Et høyt inntak av protein i uke 14-16 er assosiert med en redusert risiko for å føde et makrosomisk barn (OR=0,5). Sukkerinntaket og inntak av omega-3 fettsyrer var assosiert med fødselsvekt i univariatanalyser.

Konklusjon: Et høyt inntak av protein i gravides kost gir en signifikant lavere risiko for å føde et makrosomisk barn. Imidlertid har høyproteindietter under graviditeten vist å kunne ha en skadelig effekt og bør derfor ikke anbefales. Mange gravide spiser en ubalansert kost, som ikke er i overensstemmelse med de anbefalte retningslinjer. Mye kan sannsynligvis oppnås ved å promotere de allerede eksisterende anbefalinger, og spesielt inaktive og overvektige gravide bør få spesiell oppfølging.

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Abbreviations

BMI	Body Mass Index
BMR	Basal metabolic rate
DEXA	Dual Energy X-ray Absorptiomentry
DOHaD	Developmental Origins of Health and Disease
E%	Percent of total energy
EI	Energy intake
ELBW	Extreme low birthweight
FFQ	Food Frequency Questionnaire
IOM	(American) Institute of Medicine
LBW	Low birth weight
LGA	Large for gestational age
MBRN	Medical Birth Registry of Norway
MUFA	Monounsaturated Fatty Acids
NNR 2004	Nordic Nutrition Recommendations from 2004
PAL	Physical Activity Level
PUFA	Polyunsaturated Fatty Acids
SGA	Small for gestational age
STORK	Store barn og komplikasjoner (Large infants and complications)
VLBW	Very low birth weight

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1. Introduction

This study is a part of a cohort: 'The increasing prevalence of fetal macrosomia: A prospective study including endocrinological, metabolic, placental and nutritional characteristics of pregnant women who give birth to macrosomic infants'. The Norwegian name of the project is STORK (Store barn og komplikasjoner). The purpose of STORK is to establish better methods for identifying at-risk pregnancies so that intervention studies and/or appropriate management strategies can be improved in order to reduce:

a) Pregnancy and delivery complications (short term outcomes)

b) Long term health risks for the mother and her child (long term outcomes)

STORK is carried out in two turns: STORK 1 and STORK 2. A total of 1200 pregnant women are followed longitudinally through their pregnancy from week 14-16 until the first week post partum.

One of the main aims of STORK is to examine different determinants of intrauterine growth. The predictors of development concerning overweight and obesity in the fetus are of special interest.

In this study I am interested in exploring the nutritional determinants. Other factors have not been examined, and I have analysed data from STORK 1 exclusively, as STORK 2 data were not yet collected when the analyses were conducted.

Three PhD-students are using data from the STORK-project in their thesis, one of which is Nanna Voldner. In the thesis 'Maternal metabolic syndrome, fetal macrosomia and pregnancy complications', Voldner assesses several variables including dietary data and possible correlations to the clinical outcomes. This study is a part of her PhD-work. Voldner has assessed the effect the mean dietary intake of energy, fat, protein and carbohydrates during pregnancy has on the risk of delivering a macrosomic baby (birth weight >4200 g). However, Voldner has not examined whether the effects are more pronounced in early or late pregnancy, or if there are effects of dietary factors other than the ones mentioned. In addition, Voldner has not described the diet of the STORK population in detail, which is of great interest due to the scarcity of other studies of diet in the Norwegian pregnant population.

Consequently, I wanted to assess the effect of the dietary factors in both early and late pregnancy, not only the mean effect during pregnancy upon birth weight and the risk of infant macrosomia. I have analysed dietary data in second and third trimester of pregnancy separately, and I have included more nutritional variables than Voldner by fractioning the fatty acids and carbohydrates into different components. Finally, I have carried out a detailed descriptive dietary analysis of the diet of the pregnant women in the STORK project.

2. Background

Birth weight and fetal growth are decisive factors when it comes to the health outcomes for infant and mother, and are therefore of interest in preventive and clinical medicine. Both Genetics and the intrauterine environment provided by the mother are determinants of birth weight. This intrauterine environment may be affected by several factors including the maternal prepregnant weight, weight gain during pregnancy and physical fitness. Maternal nutrition during pregnancy is also a part of this environment, but may furthermore affect fetal genes through genetic imprinting (1-4).

Natural history cohorts, especially the one surrounding the Dutch famine of 1944–1945, have given researchers a unique way of studying the effect of nutritional deprivation during different stages of pregnancy and health outcomes for the infant (5). New studies are continuously adding updated information to the body of evidence concerning which factors affect birth weight, growth and perinatal health.

2.1. Present recommendations during pregnancy

2.1.1. Dietary recommendations during pregnancy; levels of macro- and micronutrients

According to the Nordic Nutritional Recommendations from 2004 (NNR 2004) (6), pregnant women are supposed to eat a balanced healthy diet in sufficient amounts, that in most respects is similar to what is recommended for the population at large. There are only a few exceptions from the general recommendations.

Energy needs

Pregnant women are thought to have extra energy needs due to fetal growth, and endogenous tissue growth consisting of blood, extra-cellular water, uterus, breasts, body fat and placenta. It is estimated that an average extra intake of 1.1 mega joule (MJ)/day during pregnancy is sufficient to meet these needs (6). A meal consisting of one slice of bread (30 g), margarine (5 g), ham (15 g), one apple (155 g) and one glass of semi-skimmed-milk (1.5 dl) gives approximately 1.1 MJ (260 kcal) (7). More specifically, the extra energy requirements seem to be negligible in the first trimester of pregnancy,

increased to 1.5 MJ/day in week 14-16 and as large as 2.1 MJ/day in week 30-32 of pregnancy. In addition, it is believed that many women compensate for their increasing energy needs by decreasing their level of activity, reducing the extra energy needed to less than 2.1 MJ extra per day (6).

Essential fatty acids

Essential fatty acids are the polyunsaturated fatty acids (PUFA) consisting of omega-6 and omega-3 fatty acids - that cannot be synthesized in the human body, and consequently must be provided through food intake. On the macronutrient level, the recommended intake of essential fatty acids should be higher among pregnant women than among the general population. The contribution of PUFA should contribute a minimum of 5% of the total energy intake (E%), including at least 1 E% from omega 3-fatty acids (6).

Micronutrients

During pregnancy there is an increase in the need of micronutrients. Supplement of folic acid (400 μg/day) is recommended from one month before conception, and through the first trimester for all pregnant women and women planning a pregnancy. Iron supplementation is recommended to pregnant women with anemia (Hb<10,5 g/dl), and for those who cannot cover their iron requirements through diet alone (i.e. vegans). Low Hb values (between 8,5 g/dl and 10,5 g/dl) are, however, associated with a lowered risk of low birth weight and premature birth, whereas even lower and very high levels are associated with a higher risk (8). Vitamin A intake must be kept close to the recommended levels of 800 μg/day, because both retinol deficiency and retinol excess may give fetal malformations (6). An intake of 10 μg/day of vitamin D is recommended during pregnancy to ensure optimal levels in both mother and fetus. Adaptation to calcium absorption is very efficient during pregnancy, but the recommended intake is still higher (900 mg/day) than what is recommended to non-pregnant women.

2.1.2. Prepregnant body weight

Maternal prepregnant weight or BMI (body weight in kg/height in meters^2) are positively correlated with infant birth weight, and is strongly associated with perinatal health (9-18). Maternal prepregnant underweight is associated with giving birth to infants born small for gestational age (SGA), defined in chapter 2.3.1, spontaneous preterm delivery and maternal delivery complications (11;13;14). On the contrary, maternal prepregnant overweight and obesity protects against delivery of SGA infants, but increases the risk of

stillbirth and neonatal death (10;12). In addition, maternal obesity is associated with preeclampsia, gestational diabetes mellitus, hypertension and cardiovascular disease, increased risk of miscarriage, caesarean deliveries, shoulder dystocia, postoperative complications, low Apgar score, neural tube defects and macrosomia (10;15-18).

This data indicates that the optimal maternal prepregnant BMI and weight should be within the normal range, defined by the World Health Organization (WHO) as a BMI of 18.5-24.9 kg/m^2 (19). Norwegian guidelines recommend that under- or overweight pregnant women should receive individual advice on diet and physical activity, in addition to the standard follow up in health institutions (8). New, updated Norwegian guidelines will soon be published, but are not yet available to the public (20).

2.1.3. Weight gain during pregnancy

Maternal weight gain during pregnancy is related to the infant's birth weight (21;22). A large weight gain during pregnancy is a strong predictor of delivering large for gestational age (LGA) and/or macrosomic infants (23). Yet, there are no clear recommended levels of weight gain during pregnancy in Norway, nor are there reliable data on weight gain during pregnancy in the Norwegian population. However, health workers are advised to weigh the pregnant women early, at week 8-12, and later routinely weighing them as practise through the pregnancy (8).

Despite of the lack of established recommendations, the American Institute of Medicine's guidelines (IOM) (24) on weight gain during pregnancy are suggested as a guide to health workers (8). These guidelines are based on the maternal BMI in the prepregnant state. Thus, the recommended weight gain is different for women with low weight (BMI<19.8 kg/m^2), normal weight (BMI 19.8-26 kg/m^2) and high weight (BMI 26.1-29.0 kg/m^2). These weight cut-offs are defined by the IOM (24) and differ slightly from the WHO cut-off values (19). For women within the normal weight range a weight gain between 11.5-16 kg seems to be optimal. Women within the lower weight ranges can gain up to 18 kg while obese women should ideally limit their weight gain to 6 kg, but not less. The recommendations are based on observational studies, and the recommended ranges are associated with the best outcome for both mothers and infants (24;25). However, American studies have shown that few pregnant women follow these guidelines (25).

2.1.4. Physical activity in pregnancy

When it comes to the impact of exercise during pregnancy on birth weight, there exist few studies and the findings are not consistent (26;27). However, an American study of 51 pregnant women from 2007 showed that aerobic physical activity was strongly and inversely associated with fetal growth, especially among taller women. Accordingly, aerobic physical activity in pregnancy may be an important determinant of birth weight within the normal levels (28).

Up until resent years it was not known whether physical activity during pregnancy was harmful for the fetus. However, new evidence has accumulated and shown that moderate physical activity during an uncomplicated pregnancy has no harmful effects (29;30). In a Norwegian study of 42 women it was shown that healthy and well-trained pregnant women may perform high intensity exercise during their pregnancy without compromising fetal growth and development (29).

In total, physical activity during pregnancy appears safe and seems to contribute to various health benefits: better maternal fitness, better sense of well-being, reduced physical discomfort during pregnancy and reduced risk of contracting gestational diabetes and preeclampsia (31-33).

The recommendations from The American College of Obstetricians and Gynecologists, state that in the absence of either medical or obstetric complications, 30 minutes or more of moderate exercise a day on most, if not all, days of the week is recommended for pregnant women. Extreme sports activities and activities with high risk of abdominal trauma should be avoided (30). The Nordic recommendations from 2004 (6) are generally based on the same scientific evidence as those from The American College of Obstetricians and Gynecologists, and are consequently fairly similar.

In a Norwegian study an assessment of the physical activity level during pregnancy and its association with maternal weight gain during pregnancy was conducted. All study subjects were drawn from the STORK population. Consequently, the results showed that among the pregnant women from the STORK population a high percentage of women exceeded the recommended weight gain, as well as having a low physical exercise level (34).

2.2. Epigenetics: nutrient–gene interactions

Epigenetic changes are understood as the hereditary changes in gene expression that are not mediated by DNA sequence alterations (35). Instead of changing in the DNA sequence, genes are activated or silenced. The chromatin structure affects how the DNA is packed and organized in the cell nucleus, and is decisive for the availability of transcription of the genes. There seems to be a variety of possible factors that may affect the structure of the chromatin, such as methylation, acetylation and treonine/serinephosphorylation (36).

Accumulating evidence indicates that nutrients can influence the degree of methylation and demethylation of genes, and thus induce permanent changes in gene expression, which may affect the fetus during critical periods of its development. Instances of how diet may affect the expression of genes, and hence ultimately the genotype, have been shown in several experiments, including in by Wolff et al. In their study genetically identically pregnant inbred Avy/a mice were fed different diets, hence different levels of methyl supplementation. The results showed that their offspring obtained different fur-color according to the diet they had been exposed to, ranging from brown to yellowish (37).

2.3. Birth weight

2.3.1. Infants born SGA

Infants who are 'small for gestational age' (SGA) have a birth weight far below the mean values for their gestational age when compared to an appropriate reference population (gender, ethnicity and geographic area). The most used cut-off points are birth weight below the 10^{th} percentile and 2 SDs below the mean for gestational age. In variation, the 2.5^{th} or 5^{th} percentile, or 3 SDs below the mean are used (38). The prevalence of infants born SGA depends on how this level is defined.

Different levels of low birth weight are often defined as: Low birth weight (LBW <2500 g), Very low birth weight (VLBW <1500 g) and Extreme low birth weight (ELBW <1000 g). In Norway in 2006 the prevalence of infants weighing less than 2500 g at birth was 6.6% (39).

2.3.2. Infants born macrosomic

No consensus exists when defining excessive birth weight. Born large for gestational age (LGA) has been defined in several different ways in different studies. The various definitions are: above the 90th percentile, or 2 SDs above the mean for the given gestational age in the reference population (40;41). Fetal macrosomia is normally expressed in absolute weight, with a defined cut-off weight. However, different cut-off levels flourish. Levels of ≥4000 g (grade 1), ≥4500 g (grade 2) or o ≥5000 g (grade 3) are used (42-44).

The prevalence of infants weighing more than 4000 g at birth in Norway in 2006 was 18.9%, 3.6% weighed more than 4500 g and 0.3% weighed more than 5000 g (39).

2.3.3. Optimal birth weight

When looking at high or low birth weights and their respective consequences, both are associated with increased mortality. A reversed J-shaped curve, or a U-formed curve is found, indicating a marked decrease in total-mortality risk and morbidity from the lowest birth weights up to average birth weights and then an increase towards the highest birth weights (45-47).

Nevertheless, there is no consensus of what the optimal birth weight for an infant is. When using perinatal mortality rates to locate the optimum weight, differences between different populations generate some difficulties. An epidemiological study from 2002 showed that there are significant area-specific variations in birth weight distribution and in the birth weight associated with the lowest perinatal mortality (48). The minimal perinatal mortality risk varied considerably: 3755 g in Flanders and 4305 g in Norway (48). In a Japanese study from 2006, the lowest perinatal mortality rate in singleton pregnancies was found for birth weight in between 3.5-4.0 kg (49).

There is not sufficient evidence for any firm conclusions on what is the exact optimal birth weight. Yet, when looking at perinatal mortality and total-mortality and morbidity, it is likely that an infant's optimal birth weight should be somewhere between all extreme values.

2.4. Developmental origins of adult health and disease/ Barker's hypothesis

Nutritional conditions during fetal development are strongly associated with health parameters in the individual, both with regards to short and long term consequences (1;2). This area of research is of interest because of its potential usefulness in both clinical and preventive medicine in the future. The general hypothesis claims that the fetal environment, including nutritional conditions, gives rise to epigenetic changes which may permanently affect the metabolism, structure and physiology in the fetus' future life in a manner that may increase or decrease the susceptibility to disease (3). A widely used term is 'fetal programming'. The term 'developmental origins of adult health and disease' that includes environmental programming in early postnatal life has been introduced based on 'fetal programming'. Both epidemiological and experimental studies support the hypothesis underlying developmental origins of health and disease (1;2;50;51). The International Society for Developmental Origins of Health and Disease (DOHaD) has been established to promote research within this field.

Most studies examine the health consequences that occur later in life when the child is born SGA. The main findings in these studies show that nutritional deprivation during fetal life often result in a low birth weight, which is associated with increased risk of diabetes, high blood pressure and coronary artery disease later in life (1;2).

Studies of being born LGA or macrosomic have only in recent years flourished as an area of research (4;52-56). It is now evident that giving birth to a macrosomic infant, or being born as one, is associated with a number of health risks. In a short term perspective there is an increased risk of complications during pregnancy and delivery, such as intrauterine death, artificial induction of labour, prolonged birth, birth asphyxia, injuries to the infant and the mother, increased use of instrumental vaginal deliveries and delivery by caesarean section. In addition, the mother has an increased risk of experiencing post partum haemorrhages, and the infant is more likely to develop neonatal hypoglycaemia and hyperbilirubinemia. Macrosomic infants need neonatal intensive care more often compared with normal-weight-infants (4;17;57-60).

Being born macrosomic is also associated with long-term adverse health effects in the individual. There is an increased risk of neurological sequels, adiposity, diabetes and cancer (4;55;56;61-63). It has been suggested that nutritional and metabolic imbalances

during fetal life are the contributing factors in a marked increase (33%) in childhood obesity and type 2 diabetes that has been in the United States from 1990 to 1998 (53).

In the past decades the mean birth weight and the percentage of new-borns with a birth weight >4000 g has increased in the Nordic countries, and as a consequence there has been an increase in the prevalence of macrosomic infants. New-borns in Norway weighing more than 4000 g has risen from 16% in 1990 to 22% in 2000 (64;65). There has been a minor decrease in mean birth weight in Norway since 2000, and the percentage of infants weighing 4000 g or more was 19.6% and 18.9% in 2005 and 2006, respectively (39). This may be explained by changes in the clinical approach. An increased focus on the macrosomic infants may have led to earlier induced labour and cesarean sections to ensure that the infants are born before they become too large.

Despite the minor change in recent years, the prevalence of macrosomic new-borns is still high and a source of great concern. Therefore, the factors influencing the nutritional status of the fetuses need to be assessed. Knowledge gained from this study may be essential both in clinical and preventive medicine.

2.5. Aims and definitions

2.5.1. Purpose of study

We know:

1. Earlier dietary surveys from the 1990'es have revealed inadequate dietary patterns in a population of urban, Norwegian pregnant women (66;67). Hence, descriptive studies of this group are important in order to see if dietary habits have changed.

2. The prevalence of fetal macrosomia is high in Norway (39). Since we already have gained an understanding of the adverse health outcomes associated with a high birth weight, it is important to identify contributing factors. Diet, body weight and fitness, in addition to weight gain during pregnancy, are modifiable factors. If a more certain relationship between these modifiable factors and the risk of macrosomia could be established, it will be easier to offer advice to pregnant women on how to achieve a healthier lifestyle and thus prevent adverse health outcomes.

The purpose of this thesis is therefore:

To describe the population of pregnant women and their dietary habits (aim 1); To find and describe whether or not maternal modifiable factors, especially dietary ones, contribute to a higher birth weight or higher risk of macrosomia (aim 2). Furthermore, by reviewing the literature and own findings I will attempt to evaluate whether or not the recommendations given to pregnant women on modifiable life style factors today: maternal diet, physical activity and weight gain, overweight and/or obesity, during pregnancy - are the optimal when the goal is to reduce the risk of macrosomia.

2.5.2. Aims

The specific aims are described in the following section:

1. **To describe the characteristics of the STORK population and investigate their dietary patterns during pregnancy.**
    a. To find whether or not women giving birth to a macrosomic infant can be described by specific characteristics.
    b. To investigate whether or not the dietary intakes differ between early and late pregnancy.
    c. To investigate whether or not the nutrient intake among the pregnant women are within the recommended levels.
    d. To investigate what food items contribute most to energy-intake, energy-providing nutrients and fiber in the maternal diet.
    e. To investigate the degree to which the mixed greens intake among pregnant women are within the recommended levels.

2. **To investigate to what degree and how consumption of nutrients in early and late pregnancy affects the infant's birth weight or contributes to a higher risk of macrosomia.**
    a. To investigate to what degree and how eating an 'obesogenic diet'* during pregnancy affect the infant's birth weight.

b. To investigate to what degree different levels of energy, energy-providing nutrients and fiber intake during pregnancy affects the infant's birth weight. The different levels of nutrient intake are: high, low and different quartiles.

c. To investigate to what degree eating an 'obesogenic diet'* during pregnancy contribute to a higher risk of macrosomia.

d. To investigate to what degree different levels of energy, energy-providing nutrients and fiber intake during pregnancy affects the risk of delivering a macrosomic infant. The different levels of nutrient intake are: high, low and different quartiles.

*'Obeseogenic diet'= see section: '2.5.3. Definitions'

2.5.3. Definitions

Macrosomic infant

Infant weighing ≥4200 g at birth is defined as macrosomic in the STORK project. This level was chosen because in a clinical perspective a birth weight ≥ 4200 g seems to be a cut-off-point at which the risk of where delivery-complications are notably high (20). In addition, the 4200 g level corresponds to the 90th percentile of birth weight in Norway.

Obesogenic diet

<u>High total energy</u>

When dividing the subjects into categories of high and lower energy intakes, their self-reported energy intakes were subtracted from their estimated energy needs before being grouped. Ideally, their actual energy needs (physical activity level (PAL) and Basal Metabolic Rate (BMR)) should be used to see who ate in excess of their actual energy requirements. However, PAL- levels were not available. BMR was calculated using Harris-Benedict's equation for every individual in order to reach the best possible estimate. Because the equation seems to overestimate the BMR with 5-13% among women (68), the PAL was set somewhat lower than what would be expected for pregnant women (69;70) to compensate and not to overestimate. Finally an average PAL-level of 1.3 was

set. Consequently, women in the 4th quartile when calculating 'Reported energy intake'-'Estimated energy requirements' (most positive energy-balance) were considered as subjects having a high-energy intake.

Low dietary fiber

An intake of <25 g per day OR <3 g/MJ is considered a low level.

High added sugars

Added sugars include sucrose (table sugar) and fructose. A high level is considered a level >10 E%.

High fat

A diet with >30 E% from total intake of fatty acids, including saturated, monounsaturated and omega-3 and omega-6 fatty acids is considered a high intake.

Low protein

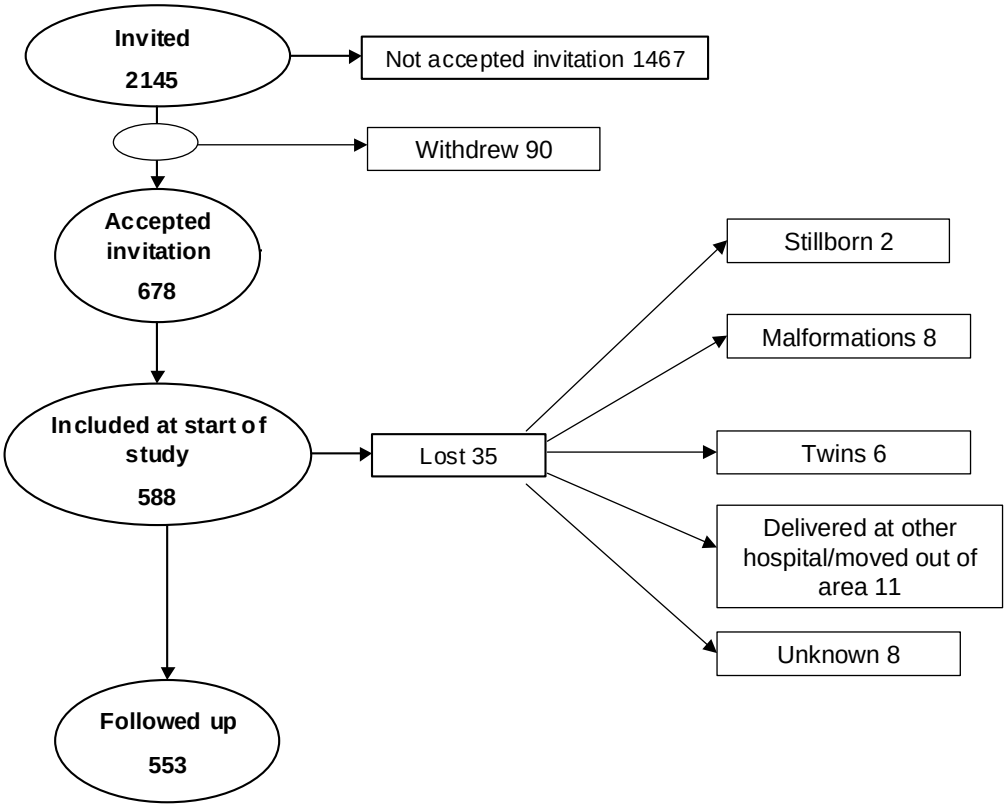
A level <15 E% from dietary protein is considered a low intake.

3. Subjects and Methods

3.1. Study design and inclusion

This prospective study with a cohort design was conducted in Oslo, the capital of Norway. A total of 588 healthy pregnant women of Scandinavian heritage were recruited from the Rikshospitalet-Radiumhospitalet Medical Centre between the year of 2002 and 2005.

Figure 1. Included subjects in STORK



Women with multiple pregnancies or with known severe diseases including diabetes mellitus type 1, lung, kidney, gastrointestinal or cardiac disease, were excluded. There were 35 recruited women lost to follow up of various reasons. Eight were excluded because of suspected fetal malformations and 6 expected more than one infant. Two intrauterine deaths occurred at term, one with unexplained cause and the other caused by the mother developing an acute fatty liver. Nineteen additional women were lost from other reasons including giving birth at another hospital, moving out of the area or retired from a

continued participation. Thus a total of 553 mother and infant-pairs formed our study group.

3.2. Data collection

3.2.1. Anthropometrical measures

All women included were followed up 4 times during the pregnancy. At visit 1 (week 14-16 of gestation) height and weight were obtained. Height was measured to the nearest centimetre if not reported by the person. Weight was measured to the nearest 100-gram on a digital scale with subjects dressed in light clothes and without their shoes on.

The newborn infants were weighed to the nearest 10-gram on a digital scale (Data Baby-Scales 930 from SOLOTOP OY, Finland) after delivery, no later than two hours after birth. Date for the delivery of the infant (gestational age) was decided at the routine ultrasound of the fetus in week 17-19, and was collected from the hospital journals.

During the time of collecting data, a change from manual to digital databases was done at the delivery unit, thus data from the first 150 deliveries were collected from paper journals and the latter from the new digital database (Obsterix, from Siemens).

Additional measurements and samples were conducted and taken both of mother and fetus during the study period, but are not discussed in further detail as they are not investigated in this thesis.

3.2.2. Dietary assessment

NORKOST

A self-administered Food Frequency Questionnaire (FFQ), NORKOST 1997 (see Appendix) was used to measure the subjects' dietary habits twice during pregnancy: week 14-16 and 30-32. Out of the 553 pregnant women in the study, 5 did not return the first FFQ from week 14-16, and 42 did not return the second FFQ from week 30-32. Thus we have dietary data from 548 women early in the second trimester (week 14-16) of pregnancy and from 511 women relatively late in the third trimester (week 30-32).

Table 1. Total of missing FFQs in the study. Study subjects reported their food intake twice.

All Participants	Returned FFQs week 14-16 of pregnancy	Returned FFQs week 30-32 of pregnancy
N=553	N=548	N=511
	5 missing	**42 missing**

The FFQ is designed to measure the mean intake the last six months or last year. It consists of questions about how often and how much is eaten of certain foods, drinks and dishes. Approximately one-hundred-and-eighty food groups are found in the questionnaire.

In STORK, subjects were to report what they usually ate at the time they completed the questionnaires. Written instructions on how to fill out the questionnaire was found on the first pages (see Appendix). Unless subjects specifically asked for it, no other instructions were given.

Nutrition calculation database

The completed FFQs were computer-scanned, and manually checked for errors, using Teleform 6.0. The same person conducted the scanning and verifying. The Database IE96 for nutrient calculations, developed at The Institute for Nutrition Research, University of Oslo, Norway, was used to calculate the food intake and the nutrient content of the participants' reported food intake. The database is based on the Food table from 1995 (71). Dietary supplements are included in the calculations (cod liver oil, multivitamin-mineral-supplements, vitamin B-, C-, D-, and E- supplements, iron, calcium and fluoride). In the newest version of the Food table from 2006, online publication (72), fiber is reckoned as a energy giving nutrient, contributing with 8 kJ/gram, in contrary to the 1995-version which the analyses in this thesis are based upon.

3.4. Statistics

All analyses are conducted using The Statistical Package of Social Sciences (SPSS, Inc., Chicago, IL, USA) version 14.0. The level of statistical significance was set at the 0.05-level, thus any p-value at this level or lower was considered a significant result.

3.4.1. Descriptive statistics

Subject characteristics

Differences between mean in groups were compared with T-test. The non-parametric alternative Mann Whitney was used to compare groups when the data in the groups were not normally distributed. Chi-square test was used to look at differences in the dichotomous characteristics. Fisher's test was used as an alternative when the assumptions of the Chi-square test were not met.

Diet and food characteristics

a) Possible alterations in dietary variables between early and late pregnancy were examined by using the paired sample T-test (2-tailed) and the non-parametric alternative Wilcoxon Signed Rank test.

b) The Database IE96 was used to calculate the amount consumed of different food-types and what food items contributed to the energy giving nutrients, energy and fiber.

3.4.2. Analysis of correlation

Pearson's correlation analysis was conducted to look at patterns between the nutrition factors from both the second and third trimester and the infant's birth weight. To check if the assumptions of normal distribution, linearity and homoscedasticity were violated, I looked at the shape of the scatterplots and the descriptive statistics. Spearman's correlation analysis was used when the assumptions of Pearson's analysis were violated.

3.4.3. Comparing groups

Obesogenic diet versus non-Obesogenic diet

Women eating an 'Obesogenic diet' were compared to women eating within the recommended levels in the New Nordic Recommendations 2004 (6). If a subject fulfilled one or more of the defined criteria she was defined as eating an obesogenic diet.

Groups were tested to see if they were both coming from a normally distributed sample. T-test was used when the dietary variables met this assumption of normality; otherwise the non-parametric test Mann-Whitney was conducted.

Quartiles

The Kolmogorov-Smirnof-test-of-Normality and histograms were used to see if the infants' birth weight were normal distributed within each group (quartile). When so, the One-Way-Anova was used to test if there was a significant difference in mean birth weight between these groups. The Bonferroni test is used in the post-hoc-testing. The non-parametric alternative was the Kruskal-Wallis Test.

Low versus high levels

Bionomic variables were constructed from the food-variables, to see if women in the 4th quartile of energy/macronutrients/fiber intake gave birth to infants weighing more or less than women with lower intakes. The 4th quartile group and the lower intake group were tested to see if they were both normally distributed, and an Independent-samples-T-test was conducted when assumptions were met. The non-parametric alternative was the Mann-Whitney test.

3.4.4. Regression

Univariate analyses

Univariate analyses were conducted prior to the multivariate analyses. Birth weight of infants was the dependent continuous variable, measured in grams. The different independent variables were dietary factors and subject characteristics. The dietary variables in this study are assumed to have a non-linear relationship with birth weight, in a similar manner as the U-formed relationship between Body Mass Index and morbidity and mortality (73). Thus dummy variables were created using quartiles, to avoid this possible problem with non-linearity. Categorical variables with more than two categories were also included in the model as dummy variables.

Linear multiple regression

Two different models were created. One included subject characteristics and dietary factors from week 14-16 of pregnancy, the other included dietary variables from week 30-32 in addition to subject factors.

Birth weight was the dependent variable as in the univariate analyses. Independent variables were included in the models based on knowledge from former research on

contributing factors to birth weight, or if they were significant in the univariate analyses at the 0.10 level and significant in the complete model at the 0.05-level.

A search in Pubmed was done to find possible studies that support inclusion of the non-significant variables. Factors that had shown significant effect on the dependent variable in earlier research were included independently of their level of statistical significance in this study. Intercorrelations between variables included in the models were checked in Spearman's correlation analyses.

The assumptions of normality, linearity and homoscedasticity for the standardized residuals, and possible problems with outliers were checked by using histograms, P-P-plots, scatterplots, collinearity diagnostics, list over residuals, and Cook's Distance.

3.4.5. Chi-Square tests

Eating an 'Obesogenic diet'

The Chi-square test was conducted to see if pregnant women eating an 'obesogenic diet' were more likely to give birth to a macrosomic infant than other pregnant women. The 'Yates Correction of Continuity' was used when constructing 2x2 tables, to compensate for the overestimate of the chi-square value in a 2x2 table. When the assumptions for Chi-square test were violated, the Fisher's Exact Test was used instead. Relative Risk estimates (RR) were calculated for statistical significant test results.

Low versus high

I wanted to find out if pregnant women who are in the 4^{th} quartile (highest) of the dietary variables were more likely to give birth to an infant weighing $\geq$4200 g, than pregnant women who were in the lower quartiles. The Chi-square test was also conducted to find possible significant differences between women in different dietary quartiles.

3.4.6. Trend test/Linear-by-linear

The Trend-test was applied to dietary variables in quartiles, because they are ordinal variables. This was done to search for trends across the ordered groups rather than just finding any difference between the groups. Trends in both the second and third trimester of pregnancy were investigated and the dietary variables divided in quartiles were the

same as those in the Chi-square-test conducted earlier. Relative Risk estimate (RR) were calculated for statistical significant test results.

3.4.7. Logistic regression

Analyses on dietary data from the second and third trimester were done separately, thus two different models were created to investigate the relationship with risk of macrosomia (birth weight ≥4200 g).

Because the dietary variables are not assumed to have a linear relationship with birth weight, these were recoded into bionomic variables, comparing the 4th quartile with the other quartiles for each variable. Variables significant at the 0.10-level in univariate analyses, and at the 0.05-level after adjusting in complete model were included. Because of the limitations of the model, a maximum of eight independent variables could be included. Assumptions of non-multi-colinearity between independent variables in the model were checked in correlations analyses prior of making the final models.

3.5. Ethics

The Regional Ethic Committee has approved this study. It is conducted according to the Declaration of Helsinki. A written informed consent was obtained from each participant and all subjects participated voluntarily (see Appendix).

4. Results

4.1. Subject characteristics, birth outcomes and diet

Maternal age ranged from 19 years to 42 years in the group of the 553 women. At the first medical visit (week 14-16) during pregnancy 42% of the subjects had a body mass index equal or higher than 25.0 kg/m^2. There was a significant difference in both body weight and body mass index when comparing women giving birth to macrosomic infants weighing (≥4200 g) with women giving birth to infants weighing <4200 g **(table 2)**.

Few subjects, only 4%, reported smoking during pregnancy. Smoking habits were not related to birth outcomes in univariate nor multivariate analysis of this cohort. A total of 99% of the women were married or lived in relationships. The majority, 84% of the women, were educated at university or college-level. None of these measures of socio-economic status were associated with birth weight **(table 2)**. Mean birth weight for the study cohort was 3619 g (SD: 571). In total, the birth weight of 84 of the infants (15%) equalled 4200 g or higher **(table 2)**.

Table 2. Characteristics of 553 pregnant women and their new-borns from Oslo and its surroundings in STORK in 2001-2005. Comparison of between macrosomic and non-macrosomic babies.

		Infant's weight at birth		
Continuous characteristics	**All N=553**	**<4200g N=469**	**≥4200g N=84**	**P-value**
Birth weight, infant (g)	3619(571)[a]			
Maternal age (years)	31(4)[a]	31(4)[a]	32(4)[a]	
Maternal weight, first visit (kg)	69(70-72)[b]	68(69-71)[b]	74(73-79)[b]	<0.001
Maternal height (cm)	169(168-169)[b1]	168(168-169)[b2]	170(168-171)[b3]	
Dichotomous characteristics (% of subjects)	**N=553**	**N=469**	**N=84**	
Smoking during pregnancy	N=22 (4%)	N=20 (4,3%)	N=2 (2,4%)	
Infant born pre-term (<37 weeks of gestation)	N=30 (5,4%)	N=30 (6,4%)	N=0 (0%)	0.015
Married/living in a relationship	N=547 (99%)	N=464 (99%)	N=83 (99%)	
Educated at college/university-level	N=467 (84%)	N=398 (85%)	N=69 (82%)	
BMI>25 kg/m^2	N=222 (42%)[1]	N=176 (39%)[2]	N=46 (58%)[3]	0.002
Parity (0)	N=293 (53%)	N=264 (56%)	N=29 (35%)	<0.001
Gender (boy)	N=295 (53%)	N=237 (51%)	N=58 (69%)	0.002

[a] mean(SD)
[b] median(95% CI)
[1] N=530
[2] N=450
[3] N=80

There were some significant differences at the 0.05-level when comparing the self-reported food-intake in the second and week 30-32 of pregnancy. In week 30-32 the percentage of energy from protein was lower, saturated fat was higher, added sugars was higher, fiber was lower compared to consumption in week 14-16 of pregnancy **(table 3)**.

Table 3. Self-reported diet among pregnant women using a FFQ (NORKOST). Nutrient intakes in week 14-16 and week 30-32 are compared.

Week 14-16 of pregnancy (N=548)						**Week 30-32 of pregnancy (N=511)**					
	Min	Max	**Mean**	SD	Median[a]	Min	Max	**Mean**	SD	Median[a]	**P-value**
Energy (kJ)	3472	15136	**8611**	2037		3674	17489	**8669**	2008		
Protein (E%)[1]	10	24	**16**	2		9	24	**15**	2		**<0.001**
Total fat (E%)[1]	18	47	**31**	5		17	49	**32**	5		
Saturated fat (E%)[1]	6	21	**12.2**	2	12	7	19	**12.4**	2	12.4	**0.03**
Monounsaturated fat (E%)[1]	6	16	**10**	2		5	18	**10**	2		
Polyunsaturated fat (E%)[1]	3	14	**6.5**	2	6.2	3	14	**6.4**	2	6.2	
Omega-6 fatty acids (E%)[1]	2	12	**5.3**	2	5.0	2	12	**5.2**	2	5.0	
Omega-3 fatty acids (E%)[1]	0.4	2.4	**1.1**	0.4	1.1	0.4	2.5	**1.1**	0.3	1.1	
Carbohydrates (E%)[1]	39	67	**53**	5	52	36	67	**53**	5	53	
Added sugar (E%)[1]	0.5	32	**8.3**	5	7.3	0.3	38	**9.0**	5	8.0	**<0.001**
Fiber (g)	6	60	**24**	8	23	9	55	**24**	7	23	
Fiber (g/MJ)	0.9	6	**2.8**	0.7	2.7	1	6	**2.7**	0.7	2.7	**0.03**

[1]Percentage from total energy intake

[a]Median presented for skewed data only

In week 14-16, 85% ate too much saturated fat, 66% too little dietary fiber, 30% too much added sugar, and 42% too little omega-3 fatty acids compared to the recommended levels in NNR 2004(6). Their nutrient intake is less in accordance with the NNR 2004 in week 30-32, when 87% ate too much saturated fat, 70% too little dietary fiber, and 31% too much added sugar **(table 4)**.

Table 4. Proportion of subjects in STORK not eating within the recommended limits (NNR 2004)

	Week 14-16 of pregnancy N=548		Week 30-32 of pregnancy N=511	
	%	N	%	N
Low dietary fiber (<3 g/MJ/day)	66	362	70	359
High added sugars, (>10 E%/day)	30	163	31	160
Low in carbohydrates, (<50 E%)	29	159	28	143
High in carbohydrates, (>60 E%)	10	52	9	45
High in total fat,(>30 E%/day)	61	335	65	331
Higher in total fat,(>35 E%/day)	26	143	23	119
High in saturated fatty acids, (>10 E%/day)	85	468	87	445
High in PUFA (>10 E%/day)	4	23	3	16
Low in omega-3 fatty acids, (<1 E%/day)	42	227	41	207
Low in protein (<10 E%)	0	0	0.8	4
High in protein (>20 E%/day)	2.7	15	2.5	13

Bread contributed with a mean of 20%, and thus the most, of the energy-intake among the pregnant women in STORK. Meat and meat products gave the most protein with a mean of 20%. Saturated fat was provided mostly by oil, margarine and butter (mean of 21%) and cheese (mean of 18%). A mean of 33% of all omega-3 fatty acids came from oil and margarine. Soft drinks with sugar contributed with a mean intake of 29% of all dietary added sugar, whereas sweets and chocolate contributed with 23% of the added sugar. Fiber was mostly provided by bread, with a mean contribution of 34% **(table 5)**.

Table 5. Type of food providing most energy and selected energy-providing nutrients in week 14-16 of pregnancy, from a self-reported FFQ. N= 548. Mean values. Numbers in percentage. For the full list, see the Appendix.

	Energy	Protein	Saturated fat	Omega-3	Added sugar	Fiber
Bread	20	16	-	10	-	34
Cakes, cookies	-	-	5	-	6	-
Cereals	9	9	4	-	-	11
Cheese	6	10	18	-	-	-
Eggs	-	-	-	-	-	-
Fish, seafoods	3	10	-	17	-	-
Fruits and berries	10	-	-	-	15	23
Meat and meat products	9	20	17	7	-	-
Milk, yoghurt, cream	11	16	14	-	17	-
Oil, margarin, butter	8	-	21	33	-	-
Potatoes	-	-	-	-	-	5
Soft drinks with sugar	-	-	-	-	29	-
Sugar (refined granulated)	-	-	-	-	6	-
Supplements	-	-	-	16	-	-
Sweets, chocolate	4	-	6	-	23	-
Vegetables	5	5	-	7	-	21

- corresponding to less than 4 %

In week 14-16 of pregnancy women in STORK consumed an average of 596 g of mixed greens daily according to the self-reported FFQ. The mean mixed greens intake in week 30-32 of pregnancy was lower, with a total of 557 g per day **(table 6)**. The full list of food-types and their contribution to different nutrients, energy and fiber in both second and third trimester is found in the Appendix.

Table 6. Amounts consumed of selected foods in the week 14-16 and week 30-32 of pregnancy, from a self-reported FFQ

	Week 14-16 of pregnancy N=548	**Week 30-32 of pregnancy** N=511
Type of food	**mean intake/day, (g)**	**mean intake/day, (g)**
Fruits and berries	***382***	***362***
Milk, yoghurt, cream	382	409
Tea	235	200
Vegetables	***214***	***195***
Bread	161	157
Softdrinks with artificial sweeteners	128	153
Softdrinks with sugar	122	116
Meat and meat products	104	101
Coffee	69	89
Fish, seafoods	47	44
Cheese	33	31

4.2. Nutrition factors affecting the infant's birth weight

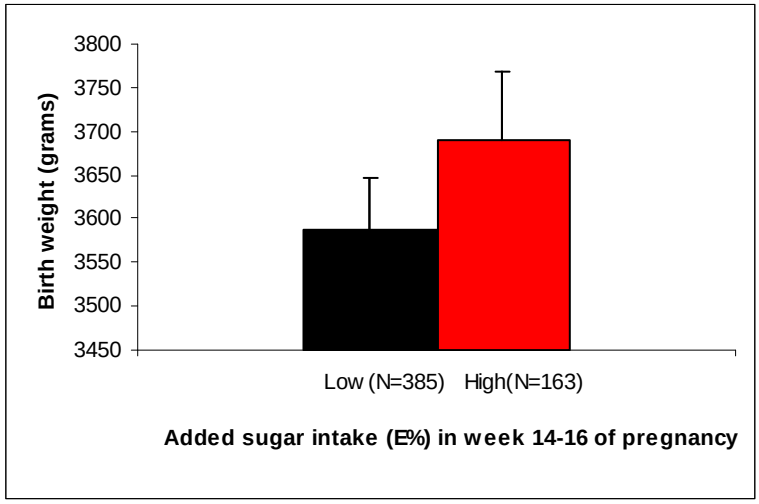
4.2.1. Obesogenic diet compared to a non-obesogenic diet

Subjects who ate a diet in which more than 10 E% of the energy came from added sugars in week 14-16 of pregnancy, gave birth to infants with a significant higher (p= 0.05) birth weight than those restricting their sugar intake to 10 E% or less in the same period. The mean birth weight of infants' whose mothers restricted the sugar intake to the recommended levels was 3588 g (SD 594), whereas a higher intake gave a mean birth weight of 3690 g (SD 506) **(figure 2)**.

There were no other significant results found at the 0.05-level in the second, or third trimester of pregnancy, when investigating whether pregnant women who ate an

'obesogenic diet' gave birth to heavier infants than pregnant women who ate within the recommended levels stated in the NNR 2004 (6).

Figure 2. Mean birth weight of infant (grams) and added sugar intake in week 14-16 of pregnancy of a total 548 subjects. Women with added sugar intake ≤10 E% gave birth to infants with a significantly lower birth weight than women with higher intakes of added sugar. The error bars represent 95% CI of the mean.

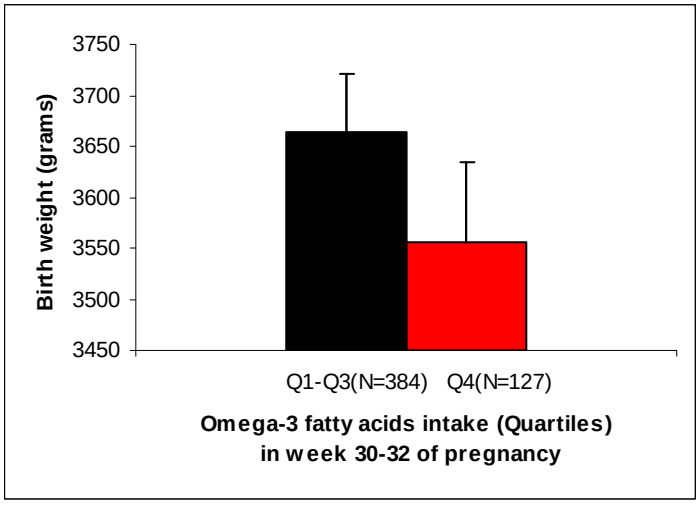


4.2.2. Different levels of dietary intake

Women with the highest consumption of omega-3 fatty acids in week 30-32 gave birth to lighter infants. Accordingly there was a significant difference (p=0.05) in birth weight between: infants whose mothers had an omega-3 intake corresponding to the 4th quartile (equal 1.3 E% or higher from omega-3 fatty acids, Mean=3556g, SD=553) in week 30-32, and infants whose mothers had lower intakes (Mean=3665g, SD=552) in week 30-32 **(figure 3)**.

No other significant differences were found in infants' birth weight whose mothers' had different intakes (of energy, nutrients and fiber) during pregnancy corresponding to defined levels and quartiles. This non-significant result was evident in the analyses conducted both in week 14-16 and week 30-32 of pregnancy.

Figure 3. Mean birth weight of infant (grams) and omega-3 fatty acids intake in week 30-32 of pregnancy of a total 511 subjects. Women with omega-3 fatty acids intake in Q1, Q2 and Q3 (<1.3 E%) gave birth to infants with a significantly higher birth weight than women with the highest intakes of omega-3 fatty acids (Q4 ≥1.3 E%). The error bars represent 95% CI of the mean.



4.3. Nutrition factors contributing to a higher risk of macrosomia

4.3.1. Obesogenic diet compared to a non-obesogenic diet

The proportion of pregnant women who gave birth to a macrosomic infant (≥4200 g) and consumed an 'obesogenic diet' during the week 14-16 or week 30-32 is not significantly different from the proportion of pregnant women who gave birth to a macrosomic infant and eating a 'non-obesogenic diet' during week 14-16 or week 30-32.

4.3.2. Different levels of dietary intake

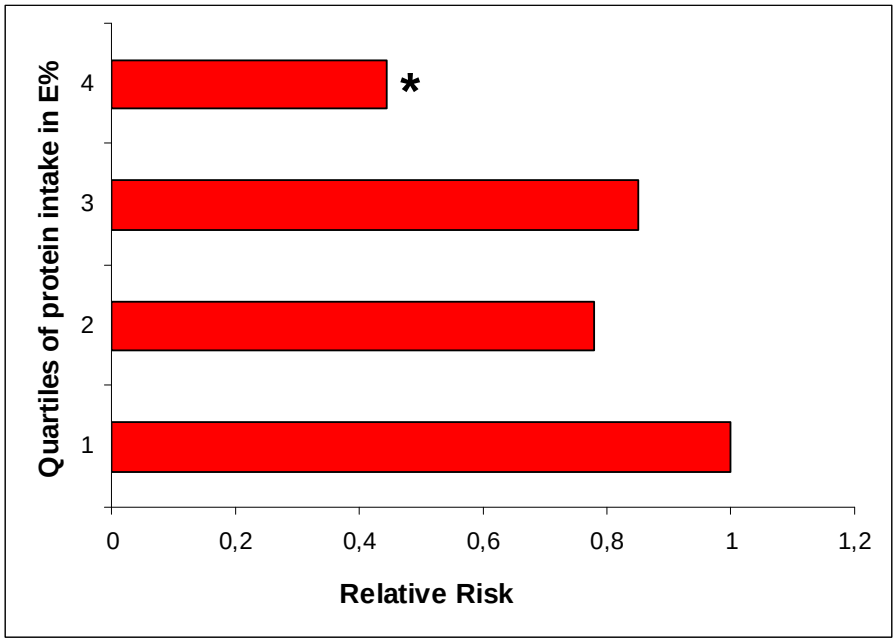
There was a significant linear trend (p=0.02) between level of protein intake in percentage of energy in week 14-16 of pregnancy and giving birth to a macrosomic infant (≥4200 g). The risk of delivering a macrosomic infant is lower when the percentage of protein in the pregnant woman's diet increases. The relative risk of giving birth to a macrosomic infant falls with 55.6% (CI: 76.5%, 15.9%) if the pregnant woman consumes higher levels of

protein (4th quartile: ≥17 E%) compared with lower levels (1st quartile: ≤ 14.3 E%) in week 14-16 of pregnancy (Chi-square: p=0.009) **(figure 4)**.

In a logistic regression model for factors related to risk of macrosomia, protein consumption in week 14-16 was the only significant dietary factor at the 0.05-level when controlling for BMI category (25 kg/m^2 or more in early pregnancy), parity, the infant's gender, gestational age and maternal birth weight. Pregnant women in the highest quartile of protein intake measured in percentage of total energy consumption (≥17 E% from protein) had an OR=0.5 (95% CI: 0.2, 0.9) of giving birth to a macrosomic infant compared to women in the lower quartiles (p=0.03) **(table 7)**.

No significant effect of the dietary variables on giving birth to a macrosomic infant (≥4200 g) were found in week 14-16 or week 30-32 of pregnancy when comparing different levels of intakes, quartiles and trends.

Figure 4. Protein intake in week 14-16 of pregnancy in different quartiles: 1st≤ 14.3 E% (reference group), 2nd>14.3 - 15.6 E%, 3rd>15.6 - 16.9 E% and 4th ≥17 E%, and RR for giving birth to a macrosomic infant (≥4200 g).



*Significantly different from the 1st quartile (at the 0.05-level).

Table 7. Logistic regression model. Factors related to giving birth to a macrosomic infant (N=501)

	P-value	**OR**	95% CI for OR	
			Lower	Upper
Protein intake ≥17E% in week 14-16 of pregnancy[1]	0.03	**0.5**	0.2	0.9
BMI category ≥25 (kg/m^2) [2]	0.02	**1.9**	1.1	3.3
Parity ≥ 1 [3]	0.002	**2.4**	1.4	4.1
Gender[4]	0.003	**2.4**	1.3	4.2
Gestational age	<0.001	**1.8**	1.4	2.2
Maternal birth weight (g)	0.006	**1.001**	1	1.001

[1]Protein intake ≥17E% (corresponding to the 4th quartile) in week 14-16 of pregnancy compared to lower intakes

[2]BMI ≥25 kg/m^2 in week 14-16 of pregnancy compared to lower BMI values

[3]Multiparous women compared to primiparous women

[4]Gender of infant: Male compared to female (reference group)

5. Discussion

5.1. Study population

5.1.1. Non-participation

There are several reasons to believe that participants in STORK may differ from the non-participants. Firstly, a study like STORK, that included four hospital visits, several questionnaires, anthropometrical measurements, blood samples and glucose tolerance tests, is time-consuming and invasive for the participants. Secondly, many pregnant women experience nausea and tiredness during pregnancy, which in turn means that participating may be found demanding. Thirdly, participants were attending antenatal controls more often than the normal population, they were also given an opportunity to attend three ultrasound scans, in contrast to only one ultrasound scan offered in the standard national antenatal care program (8). Accordingly, the participants may have a higher education level than the non-participants, they may be more interested in science or more anxious about their pregnancy, or may be older, sicker or having other reasons to be interested in close follow up during pregnancy. There were only eight drop-outs, thus drop-outs-analyses are not conducted, due to the scarce number. Besides, data from non-participants are not available; hence it remains unclear to what extent the participants are significantly different from the non-participants.

5.1.2. Comparing the STORK population to Norwegian pregnant women

Data from MBRN in 2006 (39), show that pregnant women and their infants are somewhat different from the STORK population. In Norway smoking is associated with a low socio-economic status (74), and is consequently a relevant comparable indicator. The number of smokers among all pregnant women giving birth in Norway were 15.6% in the beginning of pregnancy (83.8% response rate of all 55 509 pregnancies), and 8.5% in the last trimester. In the Oslo-area the number of pregnant smokers were 6.4% in the beginning of pregnancy (39), in comparison to the STORK population in which the number of smokers was as low as 4%. This may indicate that the STORK population come from a higher socio-economic level than the mean of the general population in Norway and Oslo.

In 2006, according to the MBRN data (39), the mean age of women giving birth was 29.7 years at a national level, and 30.8 years in Oslo, whereas it was 31 years in STORK. The mean birth weight was 3494 g at national level, 3435 g in Oslo and 3619 g in the STORK population. In total 41.5% of pregnant women in Norway and 51.3% in Oslo were primiparous in 2006, whereas in STORK 53% were expecting their first child. Overall, 93.1% in Norway, 93.2% in Oslo and 99% of women in the STORK project lived in a relationship. When comparing these data, it is important to note that 23% of the Oslo-population have a non-western background (75), whereas all the subjects in STORK are native Scandinavian.

The women in STORK have also been compared to a corresponding native Scandinavian group of 151 women giving birth at Rikshospitalet-Radiumhospitalet medical centre who were non-participants in STORK, and a second corresponding group of 85 pregnant native Scandinavian women at Ullevål University Hospital. They were all found to be quite similar when comparing age, weight before pregnancy, height (76).

These results show that the women in STORK may be different from the Norwegian population in total, but they seem to be more alike other pregnant women of Scandinavian heritage living in Oslo. Thus the results may be extrapolated to other pregnant native Scandinavian or Caucasian women from urban areas living in the western world.

5.2. Methods

5.2.1. Methods of dietary assessment

In STORK, the food frequency questionnaire, NORKOST, was chosen as the best available way to collect dietary data from the participants. When studying the food and nutrient intake in large populations, food frequency questionnaires are considered an appropriate tool because they are cost-effective; they are relatively inexpensive and easy to use both for the participant and the administrator.

It is possible that other dietary assessment methods would have provided a more accurate estimate of the food intake. A weighed diet record seems to reflect the true intake more accurate than the FFQ and 24-recall (77). However, even if the weighed diet record gives a better estimate of the nutrient intake of the participants, they require more of the participant than the FFQ. Because of the need to measure nutrient intake twice during

pregnancy, it was important to choose a questionnaire in STORK that would be most likely to be completed by as many participants as possible, in order to get the best possible data to study. Consequently, we believe the respond-rates are as good as we believe we could get with the available resources.

Validation of the FFQ

Several studies have evaluated this NORKOST questionnaire, and concluded that it measures energy and nutrient intake in an adequate way compared to other methods, as well as being suitable for Norwegian nutrition surveys (78-81). A FFQ designed especially and validated for pregnant women was not available when data collection started in 2002. Later the Norwegian Mother and Child Cohort Study designed such a questionnaire, which is being validated now (2007). This new FFQ has been analysed in analyses of correlation against NORKOST in a small sample of 86 women. The results show that energy intake correlates with 0.69 and protein correlates with 0.72 at the 0.01-level in the two different FFQs (82). These results indicate that NORKOST may be a suitable tool when measuring energy and macronutrients in a population of pregnant, native Scandinavian women.

An evaluation of the instructions and use of the FFQ

The FFQ used in STORK was originally designed to measure the mean intake the last six months or last year, whereas the participants in STORK were instructed to report what they ate at the time they completed the questionnaire. The study subjects completed two questionnaires within a time period of 14-18 weeks, corresponding to 3-4 months. This may have affected the reported intake. Accordingly, it is possible that the reported intake in week 30-32 has overlapped the actual intake in week 14-16, thus the differences in intake between early and late pregnancy may be less evident in the analyses than it is in reality.

Under-reporting

Under-reporting food intake is a well-known phenomenon in dietary surveys and is caused by a variety factors (83). Under-reporting can be divided in two subtypes: 'Under-eating' and 'under-registration'. When subjects 'under-eat', they eat less than they normally do due to the fact that they are conscious of what they are eating when reporting. When subjects are 'under-registering', they omit reporting what they actually are consuming. Energy intake (EI) divided by BMR will give an estimate whether or not subjects are having

an EI that is consistent with life over time. Under-reporters are subjects with values for EI:BMR <1.35, whereas <1.14 is not consistent with life (84).

According to these cut-off levels, 47% of subjects in STORK under-reported in week 14-16 and of these 24% had an EI:BMR <1.14. In week 30-32, 47% of subjects still under-reported according to the <1.35 cut-off level, and 23% were <1.14. This is in accordance with a recent Swedish study that concluded that it is common for pregnant women to under-report their energy intake (85). This widespread under-reporting may conceal true effects between diet and maternal -and infant health risk, and must for that reason be taken into account when discussing the results.

5.2.2. Birth weight as a method for predicting neonatal outcomes

Birth weight cut-off levels are used to define macrosomia, and consequently infants at risk for adverse health outcomes. As suggested earlier: In addition to the more mechanical short-term consequences of macrosomia, like injuries to the infant and the mother during birth, macrosomic infants have been living in an over nourished fetal environment that have affected the metabolism, structure and physiology in a permanent way, and as a result increased their risk of disease (4;55;56;61-63).

However, the question of whether birth weight is a good measurement and method for predicting neonatal outcomes or not, must be reviewed. The simple measurement of the newborn's weight cannot tell us anything about body composition and amount of fat-free-mass in the infant. When discussing fetal macrosomia understood as fetal overweight with possible metabolic changes and long-term consequences, it is possible that a distinction between genetically large fetuses and those who are overweight should be made. Fetal macrosomia is a heterogeneous condition both in terms of definition (42-44), as well as when looking at the etiological factors. In some studies it is suggested that macrosomia should not be classified on the basis of birth weight and gestational age alone. Different mathematical formulas have been suggested to relate body fat to body weight, that consist of weight for height or some power function of height. The ponderal index is one suggestion, were weight (in kilograms) is divided by the length (in meters) cubed (41). This ponderal index has been proposed as a better way of classifying macrosomic infants, also because both a symmetric and an asymmetric subtype of macrosomia have been described, and may be classified with using this ponderal index (86).

On the other hand, a study from 2004 compared birth weight, ponderal index and BMI of 9226 infants, to see which would predict admission to the neonatal intensive unit, or a prolonged hospitalization the best. With regards to these two short-term outcomes, birth weight was a better predictor than either BMI or ponderal Index (87).

Yet it seems clear that birth weight has limitations and to improve the understanding of macrosomia, studies of body-composition will be needed. There are biophysical techniques available for this purpose: Total body electrical conductivity and dual energy X-ray absorptiomentry (DEXA). However, these methods are time and resource demanding and accordingly mostly for use in scientific studies, not in clinical practice (41). In part two of the ongoing STORK study, DEXA is used on all infants. This will hopefully add more information about the macrosomic infant in terms of differentiating between the genetically large but lean infant and the morbid large infant with excessive fat tissue.

5.2.3. The 'Obesogenic diet', An evaluation

The definition 'obesogenic diet' was constructed to gather the nutritional factors at levels that were thought to contribute to a higher risk of macrosomia or have a positive effect on birth weight. The constructs of the definition are based on relevant findings in the literature and my own reflections of what may be possible relations between diet and high birth weight.

High total energy was chosen because having a positive energy-balance, meaning a higher energy-intake than the total energy requirement, will lead to excessive weight in the mother, and possibly also in the fetus. Despite methodological limitations, energy-balance is a better measurement than total energy-intake itself, due to the fact that it was possible to correct for maternal height and body weight when calculating the energy-balance.

Low dietary fiber was set at a level below the recommended level of fiber consumption in the New Nordic Recommendations from 2004 (NNR2004). There is a strong body of evidence that recommended levels of dietary fiber helps control body weight (6), and thus possible prevention of excessive fetal weight gain.

High added sugars was set at a level above the maximum recommended level of added sugar intake in NNR2004 (6). There are studies showing that intake of sweetened soft drinks is correlated with overweight and obesity (88). Sweetened soft drinks have a very high content of added sugar with 100 E% coming from added sugar (7), thus added sugar

was thought to lead to maternal overweight and obesity. In addition, it is well known from diabetic pregnancies that there is a direct relationship between maternal blood glucose levels and size at birth (89), thus a diet that may elevate the maternal blood sugar in non-diabetic women was thought to be of importance and have a possible positive effect on birth weight.

High total fat was set at a level higher than what is recommended for overweight subjects who want to prevent additional weight gain (6). Fat contributes with more energy per gram than protein or carbohydrates (7), thus a diet high in total fat was thought to easily lead to excessive maternal weight gain and possible fetal weight gain.

Low protein was set at a level that lies within the recommended level of protein intake (6). A level of protein intake of less than 10 E% would be below the recommended level. However, in the Norwegian population, the mean intake indicates that such low level is found among very few (90), thus the 'low protein' intake was defined to 15 E% or lower There is no consensus that moderate or high protein diets prevent overweight and obesity in adults, and it may seem as if the macronutrient composition of the diet is of little importance as long as the total energy intake is restricted (6;91). However a Cochrane review indicates that high protein diets during pregnancy may give lower birth weight (92), consequently this variable was included in the analyses.

The chosen constructs of the 'obesogenic diet' can be criticized because of the limited evidence supporting associations with a higher birth weight or higher risk of macrosomia. However, these factors were to be proven right or wrong in this thesis, not beforehand.

5.3. Interpretations of results

5.3.1 Women not eating within the recommended levels

Pregnant women are according to the NNR 2004 (6) supposed to eat a balanced healthy diet, similar to what is recommended to the normal population. The exceptions are higher energy intake, higher levels of essential fatty acids, and higher levels of micronutrients.

The results from the analyses reveal that a large proportion of the women in STORK are not eating within these recommended levels stated in NNR 2004. A national dietary survey from 1997 (90), using the same FFQ as used in STORK, shows that non-pregnant

Norwegian women at the age of 20-29 and 30-39 have a mean intake of 20 and 21 g of dietary fiber/day respectively, 11.8 and 9.3 E% added sugar, 12.0 and 12.7 E% from saturated fat, and 5.3 and 5.6 PUFA (including both omega-3 and omega-6 fatty acids). It is not shown how large percentage of the studied group did not follow the recommended intakes. However, when looking at mean values in the STORK population, the mean fiber intake is higher, the added sugar intake is lower, saturated fat is at the same level, and intake of PUFA is higher than in the general female population from 1997 aged 20-39. This indicates that despite the fact that many pregnant women have an unfavourable diet, they seem to be eating healthier than women of fertile age in the Norwegian population. Yet, one must be aware of the time difference between 1997 and 2002-2005, which may change the picture.

Dietary data from late 1990 from an urban pregnant Norwegian population exist (66;67). Pregnant women had a median energy intake of 8.2 MJ, saturated fat intake of 12 E%, PUFA intake of 5 E%, and 0.9 E% intake from omega-3 fatty acids. Additionally the intake was 30 E% from total fat, 8 E% from added sugar, 16 E% from protein and 21 g/day from dietary fiber. In conclusion, reported energy, total fat and saturated fat, PUFA and dietary fiber intake is slightly higher whereas MUFA and added sugar intake is marginally lower in the STORK population compared to data from the 1990-results.

Results from The Cardiovascular Risk Reduction diet in Pregnancy study (CARRDIP) showed beneficial effects, in terms of reduced risk of preterm birth, among women eating a diet low in saturated fat and cholesterol during pregnancy (93). Clausen et al imply that a maternal diet with high levels of sucrose, energy and PUFA increase the risk of preeclampsia (94). Such results substantiate the importance of influencing the pregnant population in order to reduce the large proportion of women eating a diet not within the recommended levels.

5.3.2. Knowing the contents of foods

Health workers working with pregnant women should be more aware of what food items are contributing to excess of the beneficial and less healthy nutrients to be able to guide the pregnant women.

In the STORK population, added sugar and saturated fat intake should be decreased whereas omega-3 fatty acids and dietary fiber intake should be increased. Focus in clinical

practice should be on food items, not on nutrients alone. In the STORK population, avoidance or a decrease in consumption of soft drinks, sweets and chocolates, butter, margarine, cheese, meat and meat products, milk, yoghurt and cream would be beneficial. In addition an increase in consumption of drinking water, fat reduced milk and diary products, soft vegetable oil based margarine and lean meat products, fish and seafood, and supplements such as 'Tran' (Cod liver oil), mixed greens would be advisable.

5.3.3. Maternal intake of protein and associations with birthweight

All women in the STORK study have good protein intakes at levels thought to be sufficient to meet the needs of the mother and fetus. WHO recommends an intake of 0.75 g high-quality protein per kg body weight per day, which corresponds to less than 8-10 E%, whereas the Nordic recommendations, based on estimated requirements and the Nordic dietary habits, is 10-20 E%, the same level as for the general population (6) Stated thus, the comparison in this thesis have been done between women eating moderate amounts of protein and those eating an excess amount of protein.

Analyses in this thesis show that a high maternal intake of protein in week 14-16, defined as a diet with 17 E% or above from protein, reduces the risk of having a macrosomic infant. Similar results are seen in a study of 1040 mother-infant pairs from Australia, in which an increase of absolute protein intake/day was associated with a reduction in birth weight. In addition, higher protein intake in the third trimester was associated with a reduced ponderal index among large birth weight infants but not low birth weight infants (95). Kramer and Kakuma have assessed the effect of high protein supplement in maternal diet during pregnancy, and found a non-significant reduction in birth size (92). A review article from 2006 refers to experiments in rats, that may support very high maternal protein intake during pregnancy restrict fetal growth compared to adequate, but not low, levels of protein intake (96). All this indicates that high maternal protein intake may affect birth weight negatively compared to adequate intakes, and that protein intake may affect the body composition of the infant.

One of the main focuses of the STORK study was to find factors contributing to a higher risk of macrosomia, and then to do something about these identified risk factors in clinical practice. It seems as if a high intake of protein may be favourable to reduce the risk of macrosomia. Should medical personnel and nutritionists working with pregnant women advice them to eat such a diet? Firstly, the results must be applied with caution until further

studies may confirm the same findings. Secondly, a review article from 2003 Kramer and Kakuma found that high-protein diets during pregnancy may be harmful for the infant (92). Furthermore, a study from Scotland has assessed the effect of a maternal high protein diet. A higher systolic blood pressure were found among the now adult infants of women who had a markedly increased their protein intake by eating more meat, in the second half of pregnancy (97). In addition, a study of 251 subjects, whose women had been advised to eat 0.45 kg of red meat daily during pregnancy and avoid carbohydrate-rich foods, cortisol concentrations increased 5.4% per portion of maternal meat/fish consumption per day, decreased 3.3% per portion of maternal green vegetable consumption per week. This indicates that an unbalanced maternal diet may also increase maternal cortisol levels, exposing the fetus to excess cortisol (98) which may be unfavourable for the fetus.

In conclusion, it seems clear that in despite of possible favourable effects on birth weight, it is not safe and ethically responsible to promote high-protein diets to pregnant women. The general consumption of protein in the STORK population and in the Norwegian population is high; in 1997 women in the age group 20-39 had a protein intake of around 15 E% (90), and the consumption of meat has increased since and is higher than ever registered before 2006 (99). Considering these levels and possible harmful effects of a high protein diet during pregnancy, it may be favourable to guide pregnant women to eat more mixed greens prior to meat. Meat products and cheese contribute with 29-30% of total protein intake during pregnancy, in addition to 32-35% of the already too high intake of saturated fat.

5.3.4. Maternal intake of added sugar and assosiations with birthweight

Concerning the literature, I was not able to find other studies were the effect of different maternal intakes of added sugar on the infant's birth weight in a non-diabetic population were assessed.

Intake in the STORK population of added sugar varied largely. Many of the pregnant women in STORK did not manage to limit their intake to the recommended levels. More importantly, most of the women eating more than recommended, did not exceed 20 E% from added sugar. Only one subject had an intake over 30 E%. Consequently, even though too many ate too much sugar, few had very extreme intakes. Lack of significant results in the multivariate analyses may be explained by the fact that the true physiological effect may work in a dose-response manner.

However, there is now ample evidence that a diet high in added sugar is unhealthy even when not pregnant, contributing only with 'empty-calories' which dilute the quality of the diet and increase the risk of getting dental caries (100). In addition it is well proved that a consumption of sugar-containing soft drinks is positively correlated with overweight and obesity (88): When pregnant this may increase the risk of stillbirth and neonatal death (10;12) and additional adverse health outcomes such as a higher risk of macrosomia (10;15-18). Accordingly, there is sufficient basis to assert that a reduced intake of added sugars both in the non-pregnant and pregnant state is recommendable.

5.3.5. Maternal intake of omega-3 fatty acids and assosiations with birthweight

A meta-analysis from 2006 examined the effect of omega-3 fatty acids on maternal health and fetal growth and development. They concluded that omega-3 fatty acids supplementation during pregnancy may increase pregnancy duration and head circumference, but that the mean effect size was thought to be small (101).

Another review-article from 2006 found no clear consensus regarding the effects of omega-3 fatty acids during pregnancy or the early postpartum period on duration of gestation and infant size at birth, preeclampsia, depression, infant visual function and neurodevelopment. The available data suggest only a modest effect of omega-3 fatty acids on increasing gestational duration and possibly enhancing infant neurodevelopment (102).

The results of the univariate analyses in this thesis show that the women that consumed the highest amounts of omega-3 fatty acids (corresponding to 1,3 E% from omega-3 fatty acids or higher) in late pregnancy gave birth to infants with a mean birth weight of 109 g lighter than women with a lower omega-3 fatty acids intake. This means that women with the lowest intake of omega-3 fatty acids gave birth to heavier infants. When controlling for other dietary factors and other factors, the effect was no longer significant. It is possible that these findings reflects that women with high intakes of omega-3 fatty acids have a lower BMI, which alone has a significant negative effect on birth weight.

After revising the previous mentioned review article, meta-analysis, and my own findings, the effect of omega-3 fatty acids on birth weight remains unclear. Data from randomised, clinical, double blind trials (RCT) are needed to examine the true effect. Yet, after revising the literature there is no need to question that these omega-3 fatty acids have beneficial

health effects for mother and fetus. A study of Helland et al. from 2003 (103) confirms this by showing that children with high omega-3 fatty acids status have improved IQ at the age of 4 years compared to children with lower levels. However, it is important to note that despite omega-3 fatty acids are beneficial, too high levels have shown adverse effects, such as higher risk of preeclampsia in pregnant women with consumption of >7.5 E% from PUFA compared to lower intakes (94). Consequently, a balance between low and high intakes seems optimal.

5.3.6. Diluted effects - an explanation of the absent effects

The significant effects of the maternal intake of added sugar and omega-3 fatty acids on birth weight are not very strong. In addition, no other factors from the 'obesogenic diet' than added sugar had a significant effect on birth weight, nor did it increase the risk of delivering a macrosomic infant. Birth weight is, as shown in the statistical analyses, influenced by multiple factors, such as the infant's gender, gestational age, maternal BMI among others. Thus, the effects of these nutritional variables seem to be diluted by the other determinants that affect birth weight. In STORK the number of participants are relatively large (N=553), however, only 84 infants had a birth weight ≥4200 g, which is not overwhelming. Also, if the actual effects of added sugar and omega-3 fatty acids and possible others components in the 'obesogenic diet' are small enough, it is not possible to detect them properly. Therefore it is important to remember that these nutritional variables may be dose-dependent and extreme diets, for example a very high intake of added sugar, may have physiological consequences for mother and infant, as indicated by the small effect in the univariate analysis.

5.4. BMI and physical fitness

According to the WHO's body weight categories (19), 42% of the subjects in STORK were overweight or obese at the first medical visit (week 14-16). Even though BMI is not designed for pregnant women, it was calculated from the body weight at this first visit, which was early in pregnancy. Unfortunately, very few studies have examined the weight gain pattern in the first part of a normal singleton pregnancy. However, Clapp et al. evaluated weight gain during the first 15 weeks in detail from before conception. The mean weight gain at week 7 was 2 kg and 4.3 kg at week 15 (24). It is well established that people under-report their self-reported weight and BMI (104), therefore it is not reliable and

often not possible to obtain from all participants. Thus, the weight measured at the first visit was valued to be the better choice, despite the problems with using a body weight in week 14-16 of pregnancy to calculate the BMI.

There exists accumulating convincing data, referred to earlier, which describes the adverse effects of overweight and obesity on pregnancy outcome with increased risk of macrosomia among their infants (10;15-18). In addition, the assessment of the physical activity level among women from the STORK-population, revealed a low activity level during pregnancy (34), which may increase the risk of macrosomia because physical aerobic activity is shown as important to keep birth weight within the normal range (28).

The importance of physical activity, overweight and obesity on mortality and morbidity has been discussed in several studies, and it now seems evident that it is healthier to be physical active with a normal body weight, than inactive in general. More specifically, physical fit and overweight or obese individuals actually have lower morbidity and mortality than normal weight individuals who are sedentary (105;106).

Preventing overweight and obesity and increase the physical fitness in the entire population, including women becoming pregnant, appears to be the optimal strategy to reduce mortality and morbidity, including the risk of macrosomia. However, when meeting pregnant women in clinical practice both excessive weight and inactivity are often already established, as we have seen among the women in STORK. As it is advisable to gain weight during pregnancy (24), women with excessive weight in early pregnancy should instead be advised to increase their activity level. Thus, despite of already existing recommendations for physical activity during pregnancy (8), too many seem to remain inactive, thus even more focus on physical activity before, during and after pregnancy is possibly needed. Pregnant women will most likely benefit from being encouraged to be active by receiving information about the positive effects of physical activity, types of activities they can do and at what level.

5.5. Future directions

The importance of an adequate diet and physical activity seems evident, and active weight control before and during pregnacy and physical activity in relation to the overall maternal and infant's health outcomes is described previously. However, the importance of life style

factors, including diet, in order to reduce the risk of macrosomia needs to be confirmed and explored further in detail.

A follow up study of women before and during pregnancy to assess the effect of the pre-pregnant nutritional- and fitness-state and body weight on the infant, would be ideal. In addition, future studies focusing on the diet and life style factors' effect on body composition of the macrosomic infants, and not only birth weight, are also highly relevant.

A multi centre study with participants from all over Norway, including different ethnic groups covering both urban and rural areas would be better than this limited study of an urban population of women of Scandinavian heritage. This could provide a sample with larger differences in dietary intakes, level of physical activity and body composition. More extreme values may give clearer results.

Despite the lack of scientific evidence, pregnant women are generally believed to be more open to new health information and changes than in the non-pregnant state. In addition, it is well established that children's food preferences and intake patterns are a clear reflection of the food they are exposed to in their family and close environment (107). Accordingly, dietary advice given to pregnant women may have positive health effects beyond her personal health as well as for the health of the fetus: It may also in the long run produce a change in her children and family's dietary habits.

A great effect may come from promoting the already existing recommendations. Thus, the question of how to influence pregnant women to change their diet and life style should be addressed. Clinical nutritionists and other health workers should guide pregnant women, in how to achieve a healthier life style. However, it is likely that giving information to pregnant women is not enough. Well-designed interventions and studies of how to implement the existing recommendations are most likely needed.

6. Conclusion

The prevalence of macrosomia is high in the Nordic countries, including Norway. Dietary factors seem to have a small, but not insignificant effect on the prevalence of overweight infants. Added sugar and omega-3 fatty acids intake have a significant effect on birth weight in univariate analyses, and high intakes of protein have a significantly preventive effect on the risk of delivering a macrosomic infant, also when controlling for other variables affecting birth weight. However, the effects of high protein diets during pregnancy have shown adverse health effects, and should not be promoted to pregnant women.

Too many pregnant women eat an unbalanced diet that is not within the recommended guidelines. In addition, because of an inadequate diet combined with a sedentary lifestyle the prevalence of overweight in the pregnant population is high. Added sugars from soft drinks, sweets and chocolates and saturated fat from butter, cheese and minced meat and meat products contribute strongly to an unhealthy maternal diet.

Consequently, a balanced diet within the present recommended levels, rich in mixed greens, whole grain cereals, fat reduced diary products, fish, and lean meat should be consumed, whereas soft drinks, sweets, chocolates, butter, cheese and minced meat and meat products should be limited during pregnancy. Extra attention should be given to those with a BMI not within the normal range and/or inactive subjects.

Knowledge of how to advice and reach out to the pregnant population with the right information is a challenge, and must be focused on. More research is needed to confirm previous findings or add new information, so we can tailor advice to pregnant women at risk of delivering a macrosomic infant and thus prevent negative health outcomes.

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8. Appendix

8.1. Written consent from study subjects

Rikshospitalet

Kvinneklinikken
Postadresse:
0027 OSLO

Besøksadresse:
Sognsvannsv. 20

Sentralbord:
23 07 00 00
Dir. linje:
23 07 26 30/40
Telefaks: 23 07
Org.nr.
NO 970 897 771

Deres ref:
Vår ref:
Dato:

Til deg som er gravid og har fødeplass på Rikshospitalet

Forespørsel om å delta i STORK-prosjektet

(maternelt metabolsk syndrom, store barn og svangerskapskomplikasjoner)

Stork-prosjektet søker å finne svar på hvorfor forekomsten av store barn er økende. Fra 1990 til 1999 har andelen av barn med fødselsvekt over 4kg økt fra 16% til vel 20%. Dette er en uheldig utvikling. Det er kjent at store barn kan medføre økt risiko for mor og barn under fødselen.

Bakgrunnen for undersøkelsen er at vi ønsker å vite mer om hvorfor stadig flere kvinner føder store barn. Det vil gi mulighet til å identifisere kvinner som har økt risiko for å føde stort barn tidlig i svangerskapet, og utvikle støttetiltak for å motvirke denne utviklingen.

Det finnes i dag ikke noe entydig svar på hvorfor det nå fødes flere store barn. Hos noen er det genetisk bestemt. Andre faktorer som også trolig påvirker fosterets vekst, er kvinnens fysiske aktivitet, type og mengde mat hun spiser og omsetningen av sukker i blodet.

Ved å delta i undersøkelsen vil du bli fulgt opp av en fast jordmor som er prosjektleder her på Kvinneklinikken.

Alle undersøkelsene er gratis, og du er forsikret på vanlig måte gjennom pasientskadeordningen.

Undersøkelsen er kun ute etter å samle informasjon og vil *ikke ha noen påvirkning på svangerskapet eller barnet ditt.*

Det er helt frivillig å bli med i undersøkelsen. Selv om du har begynt, kan du når som helst og uten grunn trekke deg. Dine data vil da bli slettet og ikke brukt i undersøkelsen.

Undersøkelsene:

Hvis du velger å delta, vil det bety fire kontroller på Rikshospitalet i løpet av svangerskapet. Noen av disse vil kunne være i stedet for kontroller hos egen lege / jordmor.

Hver gang møter du fastende, det betyr at du ikke skal spise eller drikke etter klokka 24.00. Du får litt vann når du kommer.

1. gang ved ca. 14-16 ukers svangerskapsvarighet
   - Kostholdsskjema som du har fått i posten skal leveres
   - Fastende blodsukkerbelastning. Du får drikke 75 g. druesukker. Deretter tas det blodprøve fire ganger (hver ½-time) for å måle hvordan kroppen reagerer på en viss mengde sukker. Vi setter inn en veneflon (et tynt plastrør) i en blodåre på armen, slik at det bare blir ett stikk. Prøven tar litt over to timer, så det er lurt å ta med lesestoff og evt. en matpakke til å spise like etterpå. Svaret vil foreligge med en gang, og du vil få vite resultatet.

2. gang ved 22-24 uker.
   - Det blir tatt blodprøve til nedfrysing. Det tar ca. 15 minutter.
   - Ultralyd av barnet for å måle vekst og trivsel. Ultralydundersøkelsen vil også måle blodgjennomstrømningen i navlesnor og til livmoren. Dette gir oss kunnskap om fosterets trivsel.

3. gang ved 30-32 uker-
   - Sukkerbelastning som første gang, pluss
   - ultralyd som andre gang
   - nytt kostholdsskjema

4. gang ved 36-38 uker
   - Blodprøver som andre gang, pluss
   - ultralyd som tidligere
   - fysisk aktivitetsskjema

Det vil hver gang tas blodprøver som skal fryses ned. Disse prøvene vil bli analysert først etter at hele prosjektet er gjennomført.

Resultatene av undersøkelsen vil bli offentliggjort i godkjente tidsskrifter.

Studien er vurdert av datatilsynet og regional etisk komite.

Med vennlig hilsen

……..
Nanna Voldner
jordmor / stipendiat

Hvis du ønsker å være med i prosjektet er det fint hvis du så raskt som mulig gir en tilbakemelding til Kvinneklinikken.

Du kan ringe til sekretær Tone Hassel 23 07 29 27 eller mobil 93 02 22 54 og si at du skal være med i STORK-prosjektet og du kan få time over telefon.

Du kan også sende en e-post til tone.hassel@rikshospitalet.no
og få time tilbake på mail.

Spørsmål kan rettes til Nanna Voldner tlf: 23 07 29 26, mobil 99 73 82 90 eller på mail. nanna.voldner@rikshospitalet.no

Jeg har mottatt skriftlig informasjon om denne undersøkelsen og samtykker i å delta.

_____ _____

Dato Underskrift

Jordmors erklæring:

Jeg bekrefter at kvinnen har fått skriftlig og muntlig informasjon om hva det innebærer å delta i prosjektet.

_____ _____

Dato Underskrift (jordmor Nanna Voldner)

8.2. Ethical approvment of STORK

UNIVERSITETET I OSLO

DET MEDISINSKE FAKULTET

To whom it may concern

Regional komité for medisinsk forskningsetikk
Sør- Norge (REK Sør)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 228 44 666
Telefaks: 228 44 661
E-post: rek-2@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 14.12.06
Deres ref.:
Vår ref.: S-01191 – approval

Title of protocol:

S-01191 Maternal metabolic syndrome, macrosomic newborn and pregnancy complications

Principal investigator: Chief physician dr.med. Tore Henriksen, Rikshospitalet.

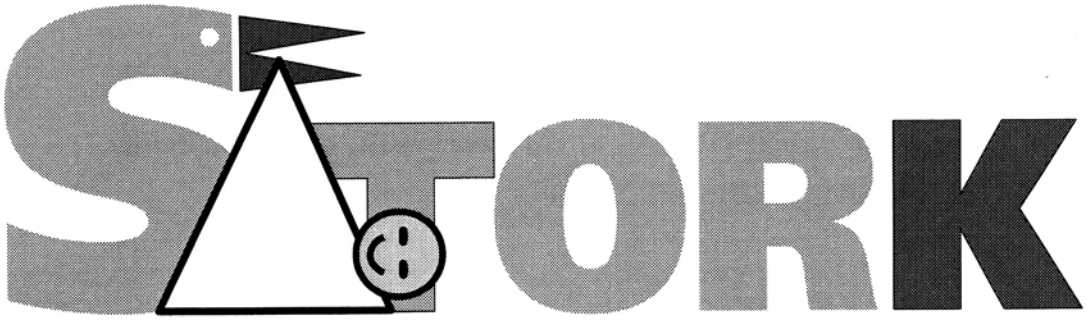
The protocol was reviewed and approved by The Regional Committee for Medical Research Ethics, Southern Norway, Oslo, Norway, on 30 August 2001.

Sincerely yours

Kristian Hagestad
Fylkeslege cand.med., spes. i samf.med
Chairman

Jørgen Hardang
Secretary

8.3. Food Frequency Questionnaire (NORKOST)



HVA SPISER DU?

I dette skjemaet spør vi om dine spisevaner slik de er nå.
Vi er klar over at kostholdet varierer fra dag til dag. Prøv derfor så godt du kan å gi et "gjennomsnitt" av dine spisevaner. Der du er usikker, anslå svaret.

Skjemaet skal leses av en maskin, og det er derfor viktig at du setter et tydelig kryss i avmerket rute.

Riktig markering er slik: ☒

Bruk helst svart eller blå kulepenn (ikke rød).
Bløt blyant kan også brukes, men marker da ekstra tydelig.

Av hensyn til den maskinelle lesingen pass på at arkene ikke blir brettet.

Alle svar vil bli behandlet strengt fortrolig.

Rikshospitalet
Universitetsklinikk

EKSEMPEL PÅ UTFYLLING AV SPØRSMÅL 1.
Kari Nordmann spiser daglig 5 skiver brød og ett knekkebrød. Hun spiser vanligvis kneippbrød, men i helgene blir det en del loff. Hun fyller ut første spørsmål slik:

1. HVOR MYE BRØD PLEIER DU Å SPISE?

Legg sammen det du bruker til alle måltider i løpet av en dag.
(1/2 rundstykke = 1 skive, 1 baguett = 5 skiver, 1 ciabatta = 4 skiver)

	Antall skiver pr. dag													
	0	1/2	1	2	3	4	5	6	7	8	9	10	11	12+
Fint brød (loff, baguetter, fine rundstykker o.l.)	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mellomgrovt brød (lys helkorn, lys kneipp, lys hj.bakt o.l.)	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐
Grovt brød (fiberkneipp, mørk kneipp, mørkt hj. bakt o.l.)	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knekkebrød (kavring, grov skonrok o.l.)	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Sum skiver pr. dag = 6
Antall skiver pr. uke: 6 x 7 = 42. Tallet brukes i spørsmål 5.

1. HVOR MYE BRØD PLEIER DU Å SPISE?

Legg sammen det du bruker til alle måltider i løpet av en dag.
(1/2 rundstykke = 1 skive, 1 baguett = 5 skiver, 1 ciabatta = 4 skiver)

	Antall skiver pr. dag													
	0	1/2	1	2	3	4	5	6	7	8	9	10	11	12+
Fint brød (loff, baguetter, fine rundstykker o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mellomgrovt brød (lys helkorn, lys kneipp, lys hj.bakt o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Grovt brød (fiberkneipp, mørk kneipp, mørkt hj. bakt o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knekkebrød (kavring, grov skonrok o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Sum skiver pr. dag = ___
Antall skiver pr. uke: ___ x 7 = ___. Tallet brukes i spørsmål 5.

2. HVA PLEIER DU Å SMØRE PÅ BRØDET?

Merk av både for hverdag og helg, selv om du bruker det samme.

Hverdager		Lørdager, søndager
☐	Bruker ikke	☐
☐	Smør (meierismør)	☐
☐	Bremykt	☐
☐	Brelett	☐
☐	Soft-, soyamargarin (pakke, beger)	☐
☐	Solsikke	☐
☐	Oliven	☐
☐	Vita	☐
☐	Olivero	☐
☐	Omega	☐
☐	Soft light	☐
☐	Vita lett	☐
☐	Annen margarin	☐

3. OM DU BRUKER FETT PÅ BRØD, HVOR MYE BRUKER DU?

En porsjonspakning på 12 g rekker til antall skiver

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐

4. MELK SOM DRIKK

(1 glass = 1,5 dl)

	Drikker sjelden/ ikke	Antall glass pr. dag: 1/2	1	2	3	4	5	6	7	8+
Helmelk, søt, sur	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lettmelk, søt, sur	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lettmelk, ekstra lett	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Skummet melk, søt, sur	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. PÅLEGGSSORTER

Bruk sum skiver pr. uke fra spørsmål 1.

Til antall skiver pr. uke

	0	1/2	1	2-3	4-5	6-7	8-14	15-21	22-28	29-35	36+
Brun ost, prim	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hvit ost, helfet, 27% fett (Jarlsberg, Norvegia o.l., smøreost; eske, tube)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hvit ost, halvfet, 16% fett (Jarlsberg, Norvegia o.l. smøreost; eske, tube)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ost med mer enn 27% fett (kremoster, Normanna, Ridderost)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	0	1/2	1	2-3	4-5	6-7	8-14	15-21	22-28	29-35	36+
Leverpostei, vanlig	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Leverpostei, mager	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Servelat, vanlig	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lett servelat, kalverull, kokt skinke, okserull o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Salt pølse, spekepølse (fårepølse, salami o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	0	1/2	1	2-3	4-5	6-7	8-14	15-21	22-28	29-35	36+
Kaviar	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Makrell i tomat, røkt makrell	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sardiner, sursild, ansjos o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Laks, ørret	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Reker, krabbe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	0	1/2	1	2-3	4-5	6-7	8-14	15-21	22-28	29-35	36+
Syltetøy, marmelade, frysetøy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Honning, sirup, sjokolade-, nøttepålegg	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	0	1/2	1	2-3	4-5	6-7	8-14	15-21	22-28	29-35	36+
Grønnsaker som pålegg (agurk, tomat o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Frukt som pålegg (banan, eple o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Salater med majones	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Majones på smørbrød	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. EGG

Antall pr. uke

	0	Mindre enn 1	1	2	3-4	5-6	7	8+
(kokt, stekt, eggerøre, omelett)	☐	☐	☐	☐	☐	☐	☐	☐

00000745

24756

7. FROKOSTGRYN, GRØT OG YOGHURT

Svar enten pr. måned eller pr. uke. <1 betyr sjeldnere enn 1 gang.

	Gang pr. måned					Gang pr. uke						Mengde pr. gang			
	0	<1	1	2	3	1	2-3	4-5	6-7	8+		1	11/2	2	3+
Havregryn,kornblandinger (4-korn, usøtet müsli o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐
Cornflakes, puffet ris, havrenøtter o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐
Havregrøt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7 ☐
Sukker til frokostgryn, grøt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ts)	1 ☐	2 ☐	3-4 ☐	5+ ☐
Yoghurt, naturell, frukt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(beger)	1/2 ☐	1 ☐	11/2 ☐	2+ ☐
Lettyoghurt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(beger)	1/2 ☐	1 ☐	11/2 ☐	2+ ☐
Go'morgen yoghurt, inkl. müsli	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(beger)	1/2 ☐	1 ☐	11/2 ☐	2+ ☐
Melk søt, sur på gryn, grøt og dessert	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	3/4 ☐	1 ☐	2 ☐	3+ ☐

8. KAFFE OG TE

(1 kopp kaffe = 1,2 dl 1 kopp te = 2 dl)

	Drikker ikke/ikke daglig	Antall kopper pr. dag 1/2	1	2	3-4	5-6	7-8	9-10	11+
Kaffe, kokt	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kaffe, traktet, filter	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kaffe, pulver (instant)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kaffe, koffeinfri	☐	☐	☐	☐	☐	☐	☐	☐	☐
Te	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nypete, urtete	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Antall teskjeer eller biter pr. kopp 0	1/2	1	2	3	4+
Sukker til kaffe	☐	☐	☐	☐	☐	☐
Sukker til te	☐	☐	☐	☐	☐	☐
Kunstig søtstoff til kaffe eller te	☐	☐	☐	☐	☐	☐
Fløte til kaffe	☐	☐	☐	☐	☐	☐

9. ANDRE DRIKKER

Svar enten pr. måned eller pr. uke. < 1 betyr sjeldnere enn 1 gang. Merk at porsjonsenhetene er forskjellige. 1/3 liter tilsvarer en halvflaske øl og 2/3 liter tilsvarer en helflaske.

	Gang pr. måned					Gang pr. uke						Mengde pr. gang						
	0	<1	1	2	3	1	2-3	4-5	6-7	8+		1/2	1	2	3	4	5+
Vann	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(glass)	☐	☐	☐	☐	☐	☐
Appelsinjuice	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(glass)	☐	☐	☐	☐	☐	☐
Annen juice, most, nektar	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(glass)	☐	☐	☐	☐	☐	☐
Saft, solbærsirup m. sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(glass)	☐	☐	☐	☐	☐	☐
Saft, kunstig søtet	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(glass)	☐	☐	☐	☐	☐	☐
Brus, Cola, Solo o.l. med sukker	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(liter)	1/4 ☐	1/3 ☐	1/2 ☐	2/3 ☐	1 ☐	11/2+ ☐
Brus, Cola, Solo o.l. kunstig søtet	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(liter)	1/4 ☐	1/3 ☐	1/2 ☐	2/3 ☐	1 ☐	11/2+ ☐
Farris, Selters, Soda o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(liter)	1/4 ☐	1/3 ☐	1/2 ☐	2/3 ☐	1 ☐	11/2+ ☐
Alkoholfritt øl, vørterøl, lettøl	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(liter)	1/4 ☐	1/3 ☐	1/2 ☐	2/3 ☐	1 ☐	11/2+ ☐
Pilsnerøl	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(liter)	1/4 ☐	1/3 ☐	1/2 ☐	2/3 ☐	1 ☐	11/2+ ☐
Vin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(glass)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6+ ☐
Brennevin, likør	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(1 dram =4cl)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6+ ☐

10. MIDDAGSRETTER

Vi spør både om middagsmåltidene og det du spiser til andre måltider. Tell til slutt sammen antall retter du har merket av for å se om summen virker sannsynlig. En "dl" tilsvarer omtrent mengden i en suppeøse. Med "ss" menes en spiseskje.

	Gang pr. måned										Mengde pr. gang					
	0	<1	1	2	3	4	5-6	7-8	9+		1/2	2/3	1	11/2	2+	
Kjøttpølse, medisterpølse	☐	☐	☐	☐	☐	☐	☐	☐	☐	(kjøttpølse)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Hamburger, karbonader o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Grill- og wienerpølse	☐	☐	☐	☐	☐	☐	☐	☐	☐	(pølse)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Hamburger-, pølsebrød, lomper	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Kjøttkaker, medisterkaker, kjøttpudding	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Kjøttdeigretter (saus eller gryte med kjøttdeig, lasagne o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Taco (med kjøtt og salat)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Pastaretter	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐	☐	

	Gang pr. måned										Mengde pr. gang					
	0	<1	1	2	3	4	5-6	7-8	9+		1/8	1/4	1/2	3/4	1+	
Pizza (500-600 g)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(pizza)	☐	☐	☐	☐	☐	
											1/2	1	11/2	2	21/2+	
Biff (alle typer kjøtt)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1/2	1	11/2	2	21/2+	
Koteletter (lam, okse, svin)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1-2	3-4	5-6	7-8	9+	
Stek (lam, okse, svin)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skive)	☐	☐	☐	☐	☐	
											1-2	3-4	5-6	7-8	9+	
Stek (elg, hjort, reinsdyr o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skive)	☐	☐	☐	☐	☐	
Gryterett med helt kjøtt, frikassè, fårikål o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Lapskaus, suppelapskaus, betasuppe	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
											1-2	3-4	5-6	7-8	9+	
Bacon, stekt flesk	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skive)	☐	☐	☐	☐	☐	
											1/4	1/3	1/2	3/4	1+	
Kylling, høne	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1-2	3-4	5-6	7-8	9+	
Leverretter	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skive)	☐	☐	☐	☐	☐	
	0	<1	1	2	3	4	5-6	7-8	9+							
Fiskekaker, fiskepudding, fiskeboller	☐	☐	☐	☐	☐	☐	☐	☐	☐	(kake)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
											1-2	3-4	5-6	7-9	10+	
Fiskepinner	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Torsk, sei, hyse (kokt)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Torsk, sei, hyse (stekt, panert)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Sild (fersk, speket, røkt)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(filet)	☐	☐	☐	☐	☐	
											1/2	1	11/2	2	3+	
Makrell (fersk, røkt)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(filet)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Laks, ørret (sjø, oppdrett)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skive)	☐	☐	☐	☐	☐	
Fiskegryte, -grateng, suppe med fisk	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
											1	2	3	4	5+	
Reker, krabbe	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl, renset)	☐	☐	☐	☐	☐	
	0	<1	1	2	3	4	5-6	7-8	9+							
Risgrøt, annen melkegrøt	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
											1-2	3-4	5-6	7-8	9+	
Pannekaker	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
Suppe (tomat, blomkål, ertesuppe o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Vegetarrett, vegetarpizza, grønnsaksgrateng, -pai	☐	☐	☐	☐	☐	☐	☐	☐	☐	(bit/dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
	0	<1	1	2	3	4	5-6	7-8	9+		1/2	1	11/2	2	21/2+	
Brun/hvit saus	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐	☐	
Smeltet margarin, smør til fisk	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
											1	2	3	4	5+	
Bearnaisesaus o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Majones, remulade	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	☐	☐	☐	☐	☐	
											1	2	3	4	5+	
Ketchup	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	☐	☐	☐	☐	☐	

11. POTETER, RIS, SPAGHETTI, GRØNNSAKER

Svar enten pr. måned eller pr. uke. < 1 betyr sjeldnere enn 1 gang.
Disse spørsmålene dreier seg først og fremst om tilbehør til middagsretter, men spiser du for eksempel en rå gulrot eller salat til lunsj, skal det tas med her.

	Gang pr. måned					Gang pr. uke						Mengde pr. gang					
	0	<1	1	2	3	1	2-3	4-5	6-7	8+		1	2	3	4	5+	
Poteter, kokte	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐	☐	
Pommes frites, stekte poteter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Potetmos, -stuing, gratinerte poteter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Ris	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Spaghetti, makaroni, pasta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Gulrot	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1/2 ☐	1 ☐	11/2 ☐	2 ☐	3+ ☐	
Hodekål	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skalk)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Kålrot	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(skive)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Blomkål	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(bukett)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Brokkoli	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(bukett)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Rosenkål	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Grønnkål	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Løk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Spinat, andre bladgrønns.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Sopp	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Avocado	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1/4 ☐	1/2 ☐	3/4 ☐	1 ☐	11/4+ ☐	
Paprika	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(strimmel)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Tomat	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1/2 ☐	1 ☐	11/2 ☐	2 ☐	3+ ☐	
Tomatbønner, bønner/linser	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Mais	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	1-2 ☐	3-4 ☐	5-6 ☐	7-8 ☐	9+ ☐	
Erter, frosne grønnsak-blandinger	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Salatblandinger	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4 ☐	5+ ☐	
Dressing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	1/2 ☐	1 ☐	2 ☐	3 ☐	4+ ☐	
Rømme	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(ss)	1/2 ☐	1 ☐	2 ☐	3 ☐	4+ ☐	

Hvor mange ganger om dagen spiser du vanligvis grønnsaker utenom grønnsakene du spiser til middag? 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5+ ☐

12. TYPE FETT TIL MATLAGING

Smør/margarin

- ☐ Smør (meierismør)
- ☐ Bremykt
- ☐ Melange, Per
- ☐ Soft-, soyamargarin (pakke, beger)
- ☐ Solsikke
- ☐ Oliven
- ☐ Annen margarin

Oljer

- ☐ Olivenolje
- ☐ Soyaolje
- ☐ Maisolje
- ☐ Solsikkeolje
- ☐ Valnøttolje
- ☐ Andre oljer

13. FRUKT

Svar enten pr. måned eller pr. uke. < 1 betyr sjeldnere enn 1 gang.

	Gang pr. måned					Gang pr. uke						Mengde pr. gang			
	0	<1	1	2	3	1	2-3	4-5	6-7	8+		1/2	1	2	3+
Eple	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐
Appelsin, mandarin, grapefrukt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐
Banan	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐
Druer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(klase)	☐	☐	☐	☐
Eksotisk frukt (kiwi, mango)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐
Annen frukt (fersken, pære m.v.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	☐	☐	☐	☐
Jordbær, bringebær (friske, frosne)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐
Blåbær	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐
Multer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐

Hvor mange frukter spiser du vanligvis pr. dag? 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9+ ☐

14. DESSERT, KAKER, GODTERI

Svar enten pr. måned eller pr. uke. < 1 betyr sjeldnere enn 1 gang.

	Gang pr. måned					Gang pr. uke						Mengde pr. gang			
	0	<1	1	2	3	1	2-3	4-5	6-7	8+		1/2	1	2	3+
Hermetisk frukt, fruktgrøt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	☐	☐	☐	☐
Puddinger (sjokolade, karamell o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4+ ☐
Is (1 dl=1 pinne=1 kremmerhus)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1 ☐	2 ☐	3 ☐	4+ ☐
Boller, julekake, kringle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1 ☐	2 ☐	3 ☐	4+ ☐
Skolebrød, skillingsbolle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1 ☐	2 ☐	3 ☐	4+ ☐
Wienerbrød, -kringle o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1 ☐	2 ☐	3 ☐	4+ ☐
Smultring, formkake	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1 ☐	2 ☐	3 ☐	4+ ☐
Vafler	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(plate)	1/2 ☐	1 ☐	2 ☐	3+ ☐
Sjokoladekake, bløtkake, annen fylt kake	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1/2 ☐	1 ☐	2 ☐	3+ ☐
Søt kjeks, kakekjeks (Cookies, Bixit, Hob Nobs)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1-2 ☐	3-4 ☐	5-6 ☐	7+ ☐
Sjokolade (60 g)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(plate)	1/2 ☐	1 ☐	2 ☐	3+ ☐
Drops, lakris, seigmenn o.l.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(stk)	1-2 ☐	3-4 ☐	5-6 ☐	7+ ☐
Smågodt (1 hg = 100g)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(hg)	1/2 ☐	3/4 ☐	1 ☐	11/2+ ☐
Potetgull (1 pose 100g=7 dl)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7+ ☐
Annen snacks (skruer, crisp, saltstenger, lettsnacks o.l.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(dl)	1-2 ☐	3-4 ☐	5-6 ☐	7+ ☐
Peanøtter, andre nøtter (1 pose 100g = 4 never)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	(neve)	1 ☐	2 ☐	3 ☐	4+ ☐

15. KOSTTILSKUDD (bs = barneskje, ts = teskje)

	Hele året	Bare vinterhalvåret	Gang pr. uke: 0	<1	1	2-3	4-5	6-7	Mengde pr. gang				
										1 ts	1 bs	1 ss	
Tran	☐	☐	☐	☐	☐	☐	☐	☐		☐	☐	☐	
Trankapsler	☐	☐	☐	☐	☐	☐	☐	☐	kapsler	1 ☐	2+ ☐		
Fiskeoljekapsler	☐	☐	☐	☐	☐	☐	☐	☐	kapsler	1-2 ☐	3-4 ☐	5-6 ☐	7+ ☐
Multipreparater													
Sanasol	☐	☐	☐	☐	☐	☐	☐	☐	bs	1 ☐	2 ☐	3 ☐	4+ ☐
Biovit	☐	☐	☐	☐	☐	☐	☐	☐	bs	1 ☐	2 ☐	3 ☐	4+ ☐
Vitaplex	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Kostpluss	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Vitamineral	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Annet	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐

Hvis annet, hvilket?.....

Jernpreparater													
Ferro C	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Hemofer	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Duroferon Duretter	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Annet	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐

Hvis annet, hvilket?.....

B-vitaminer	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
C-vitamin	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
D-vitamin	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
E-vitamin	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Folat (folsyre)	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Kalktabletter	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Fluortabletter	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐
Annet	☐	☐	☐	☐	☐	☐	☐	☐	tablett	1 ☐	2 ☐	3 ☐	4+ ☐

Hvis annet, hvilket?.....

16. NÅR SPISER DU PÅ HVERDAGER?

HOVEDMÅLTIDER som frokost, formiddagsmat, middag, kvelds.

Omtrent klokken

6	8	10	12	14	16	18	20	22	24	2	4
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐

MELLOMMÅLTIDER som kaffe, frukt, godteri, snacks m.v.

Omtrent klokken

6	8	10	12	14	16	18	20	22	24	2	4
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐

17. MENER DU SVARENE I SPØRRESKJEMAET GIR ET BRUKBART BILDE AV KOSTHOLDET

Ja ☐ Nei ☐

Er det matvarer/produkter du regelmessig bruker, og som ikke er nevnt i skjemaet?

.....

.....

18. ER DU FORNØYD MED KROPPSVEKTEN DIN SLIK DEN ER NÅ?

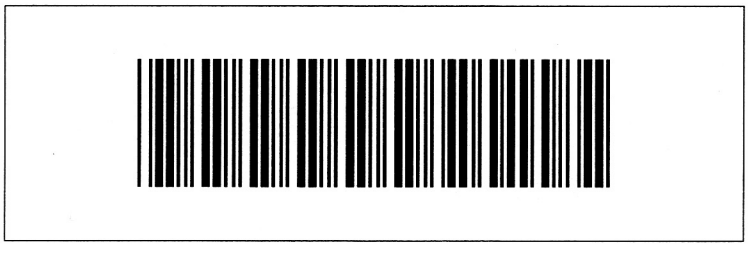
- ☐ Ja
- ☐ Nei, jeg ønsker å slanke meg
- ☐ Nei, jeg ønsker å legge på meg

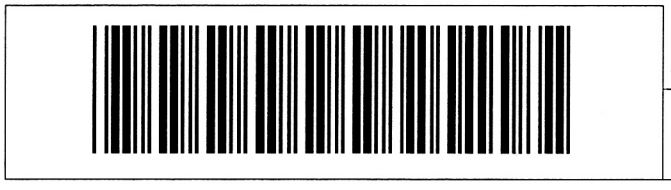
19. KJØNN

Mann ☐ Kvinne ☐

Vennligst se etter at du har svart på alle spørsmål.

Takk for innsatsen!





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8.4. Food items providing energy, energy-giving nutrients and fiber

8.4.1. In week 14-16

8.4.2. In week 30-32

8.4.1. Type of food providing most energy and selected energy-providing nutrients in week 14-16 of pregnancy, from a self-reported FFQ. N=548. Mean values. Numbers in percentage.

	Energy	Protein	Total fat	Carbohydrates	Added sugar	Fiber	Saturated fat	MUFA	PUFA	Omega-6	Omega-3
Bread	20	16	7	29	-	34	-	-	14	16	10
Cakes, cookies	-	-	4	-	6	-	5	-	4	4	-
Cereals	9	9	-	13	-	11	4	-	4	4	-
Cheese	6	10	11	-	-	-	18	10	-	-	-
Eggs	-	-	-	-	-	-	-	-	-	-	-
Fish, seafoods	3	10	5	-	-	-	-	5	7	4	17
Fruits and berries	10	-	-	18	15	23	-	-	-	-	-
Meat and meat products	9	20	17	-	-	-	17	23	9	9	7
Milk, yoghurt, cream	11	16	9	10	17	-	14	8	-	-	-
Oil, margarin, butter	8	-	26	-	-	-	21	22	43	46	33
Potatoes	-	-	-	4	-	5	-	-	-	-	-
Soft drinks with sugar	-	-	-	5	29	-	-	-	-	-	-
Sugar (refined granulated)	-	-	-	-	6	-	-	-	-	-	-
Supplements	-	-	-	-	-	-	-	-	-	-	16
Sweets, chocolate	4	-	5	5	23	-	6	5	-	-	-
Vegetables	5	5	4	5	-	21	-	-	6	5	7

- corresponding to less than 4 %

8.4.2. Type of food providing most energy and selected energy-providing nutrients in week 30-32 of pregnancy. From a self-reported FFQ. N=511. Mean values. Numbers in percentage.

	Energy	Protein	Total fat	Carbohydrates	Added sugar	Fiber	Saturated fat	MUFA	PUFA	Omega-6	Omega-3
Bread	19	16	7	28	-	33	-	4	14	15	9
Cakes, cookies	4	-	4	4	7	-	5	-	5	5	-
Cereals	10	10	-	13	-	13	-	-	4	5	-
Cheese	5	9	10	-	-	-	16	10	-	-	-
Eggs	-	-	-	-	-	-	-	-	-	-	-
Fish, seafoods	-	9	4	-	-	-	-	5	6	4	16
Fruits and berries	10	-	-	17	15	24	-	-	-	-	-
Meat and meat products	9	20	16	-	-	-	16	22	9	9	6
Milk, yoghurt, cream	11	18	10	11	17	-	15	9	-	-	-
Oil, margarin, butter	8	-	25	-	-	-	20	21	43	46	32
Potatoes	-	-	-	4	-	5	-	-	-	-	-
Soft drinks with sugar	-	-	-	4	25	-	-	-	-	-	-
Sugar (refined granulated)	-	-	-	-	6	-	-	-	-	-	-
Supplements	-	-	-	-	-	-	-	-	4	-	17
Sweets, chocolate	5	-	6	6	26	-	8	6	-	-	-
Vegetables	4	5	4	4	-	19	-	4	5	5	6

- corresponding to less than 4 %